START

CLOSURE/POST CLOSURE PLAN
1301-N LIQUID WASTE DISPOSAL FACILITY

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FOREWORD

The U.S. Department of Energy, Richland Operations Office (DOE-RL) Part B Permit Application for the Hanford Site consists of separate permit applications for the following hazardous waste treatment, storage, and disposal units:

1. The Nonradioactive Dangerous Waste Landfill and Storage Facilities
2. The Alkali Metal Treatment and Storage Facilities
3. The Low-Level Burial Grounds and Retrievable Storage Facilities
4. The 1324-N Surface Impoundment
5. The 1706-KE Waste Treatment System

The following facilities are known to have received hazardous waste. These facilities will continue to operate, receiving only non-regulated wastes, and are described in a closure/post-closure plan:

1. 216-B-3 Pond
2. 216-A-29 Ditch
3. 216-B-63 Trench
4. 2101-M Pond
5. 100-D Ponds
6. 1324-NA Percolation Pond (closure plan only)
7. The 300 Area Process Trenches

In addition, the following hazardous waste treatment, storage, and disposal units will be closed under interim status and have been described in a closure and/or post-closure plan:

1. Solar Evaporation Basins

2. Solvent Evaporator (Closure Plan only)

3. The 1301-N Liquid Waste Disposal Facility

Each separate permit application and/or closure/post-closure plan provides a complete description of the hazardous waste management activities as is required in the Washington Administrative Code (WAC) 173-303-806, Title 40 Code of Federal Regulations (CFR) Part 270 Subpart B and WAC 173-303-400 (40 CFR 265 Subpart G), respectively. It is anticipated that each separate Part B permit application will be reviewed individually and will undergo subsequent revisions prior to acceptance by the State of Washington Department of Ecology (WDOE) or the U. S. Environmental Protection Agency (EPA), Region X.

At the time this document was prepared, the EPA had not authorized the State of Washington to regulate radioactive mixed wastes under the Resource Conservation Recovery Act (RCRA) and EPA indicated in a July 3, 1986, Federal Register Notice that currently authorized state programs do not apply to radioactive mixed wastes (51 Federal Register 24504). Neither the EPA nor the State of Washington have regulations which specifically address radioactive mixed wastes and it is currently uncertain how such wastes will be regulated. However, since the State of Washington has applied to EPA for authority to regulate radioactive mixed wastes, this plan has been written to existing state regulation on the assumption that the state will be authorized to regulate these wastes before the plan is acted upon. If this expectation does not occur, or if specific regulations addressing radioactive mixed wastes are adopted, any necessary changes to this plan will be made by amendment.

The following submittal contains the DOE-RL Closure Plan for the 1301-N Liquid Waste Disposal Facility.

1.0 PART A APPLICATION

1.1 INTRODUCTION

Volume 2 of the U.S. Department of Energy (DOE-RL) Part A Permit Application was prepared for submittal to the State of Washington Department of Ecology (WDOE) and the U.S. Environmental Protection Agency (EPA), Region X, on August 15, 1986. It contained waste designation and treatment process information for the DOE-RL 1301-N Liquid Waste Disposal Facility (LWDF), which is located in the 100-N Area of the Hanford Site.

Until September 1985, the 1301-N LWDF was the primary liquid radioactive waste disposal facility for the N Reactor. Wastes disposed of in the 1301-N LWDF consisted of reactor coolant system bleed off, spent fuel storage basin bleed off, periphery cooling systems bleed off, reactor primary coolant loop decontamination rinse solution, and discharges from building drains containing radioactive wastes generated in reactor support facilities.

The 1301-N LWDF is a former land disposal facility that made use of the natural filtration properties of soil to remove radioactive material from effluent water. Radioactive materials included in the discharged wastes were retained in the soil by the filtration, adsorption and ion exchange which occurred in the soil column underlying the 1301-N LWDF.

1.2 PART A APPLICATION

The following Part A Application contains waste process information and waste designation codes for the 1301-N Liquid Waste Disposal Facility.

FORM 3

1301-N LIQUID WASTE DISPOSAL FACILITY

PART A

DANGEROUS WASTE PERMIT FORMS

(FORMS 1 and 3)

WASHINGTON STATE
DANGEROUS WASTE PERMIT
GENERAL INFORMATION

Permit Application Process

There are two parts to a Dangerous Waste Permit Application—Part A and Part B. Part A consists of Form 1 and Form 3. Part B requires detailed site-specific information such as geologic, hydrologic, and engineering data. WAC 173-303-800 specifies the information that will be required from dangerous waste management facilities in Part B.

Operation During Interim Status

Part A of the permit application defines the processes to be used for treatment, storage, and disposal of dangerous wastes; the design capacity of such processes; and the specific dangerous wastes to be handled at a facility during the interim status period. Once Part A is submitted to the Department of Ecology, changes in the dangerous wastes handled, changes in design capacities, changes in processes, and changes in ownership or operational control at a facility during the interim status period may only be made in accordance with the procedures in WAC 173-303-820. Changes in quantity of waste handled at a facility during interim status can be made without submitting a revised Part A provided the quantity does not exceed the design capacities of the processes specified in Part A of the permit application. Failure to furnish all information required to process a permit application is grounds for termination of an interim status permit.

Confidential Information

All information submitted in this form will be subject to public disclosure, to the extent provided by RCRA and the Freedom of Information Act, 5 U.S.C. Section 552, and EPA's Business Confidentiality Regulations, 40 CFR Part 2 *(see especially 40 CFR 2.305)*, and will be subject to the State of Washington Public Records Act chapter 42.17 RCW and chapter 43.21A-160 RCW. Persons filing this form may make claims of confidentiality. Such claims must be clearly indicated by marking "confidential" on the specific information on the form for which confidential treatment is requested or on any attachments, and must be accompanied at the time of filing, by a written substantiation of the claim, by answering the following questions:

Confidential Information (continued)

A. Which portions of the information do you claim are entitled to confidential treatment?

B. For how long is confidential treatment desired for this information?

C. What measures have you taken to guard against undesired disclosure of the information to others?

D. To what extent has the information been disclosed to others, and what precautions have been taken in connection with that disclosure?

E. Has the Department of Ecology, EPA or any other Federal or State agency made a pertinent confidentiality determination? If so, what would those harmful effects be and why should they be viewed as substantial? Explain the causal relationship between disclosure and the harmful effects.

If no claim of confidentiality or no substantiation accompanies the information when it is submitted, EPA or the department may make the information available to the public without further notice to the submitter.

Definitions

Terms used in these instructions and in this form are defined in the Definitions section of the Dangerous Waste Regulation, chapter 173-303 WAC

This form must be completed by all applicants.

Completing This Form

Please type or print. If you print, place each character between the marks. Abbreviate if necessary to stay within the number of characters allowed for each item. Use one space for breaks between words, but not for punctuation marks unless they are needed to clarify your response.

Section I

Space is provided at the upper right hand corner of Form 1 for insertion of your EPA/State identification number. If you have an existing facility, enter your identification number. If you don't have an EPA/State identification number, please contact the Department of Ecology (206) 459-6303 and one will be provided for you. If your facility is new (not yet constructed), leave this item blank.

Section II

Enter the facility's official or legal name. Do not use a colloquial name.

Section III

Give the name, title, and work telephone number of a person who is thoroughly familiar with the operation of the facility and with the facts reported in this application and who can be contacted if necessary.

Section IV

Give the complete mailing address of the office where correspondence should be sent. This often is not the address used to designate the location of the facility or activity.

Section V

Give the address or location of the facility identified in Section III of this form. If the facility lacks a street name or route number, give the most accurate alternative geographic information (e.g., section number or quarter section number from county records or at intersection of Rts. 425 and 22).

Section VI

List, in descending order of significance, the four 4-digit standard industrial classification (SIC) codes which best describe your facility in terms of the principal products or services you produce or provide. Also, specify each classification in words. These classifications may differ from the SIC codes describing the operation generating the dangerous wastes.

SIC code numbers are descriptions which may be found in the "Standard Industrial Classification Manual" prepared by the Executive Office of the President, Office of Management and Budget, which is available from the Government Printing Office, Washington, D.C. Use the current edition of the manual. If you have any questions concerning the appropriate SIC code for your facility, contact your Department of Ecology Regional office (see Table 1).

Table 1 Department of Ecology Regional Offices

Northwest Regional Office
4350 - 150th NE
Redmond, Washington 98052
Tel: 206-885-1900

Southwest Regional Office
7272 Cleanwater Lane
Olympia, Washington 98504
Tel: 206-753-2353

Eastern Regional Office
East 103 Indiana
Spokane, Washington 99207
Tel. 509-456-2926

Central Regional Office
3601 West Washington
Yakima, Washington 98903
Tel: 509-575-2490

Section VII-A

Give the name, as it is legally referred to, of the person, firm, public organization, or any other entity which operates the facility described in this application. This may or may not be the same name as the facility. The operator of the facility is the legal entity which controls the facility's operation rather than the plant or site manager. Do not use a colloquial name.

Section VII-B

Indicate whether the entity which operates the facility also owns it by marking the appropriate box.

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Section VII-C

Enter the appropriate letter to indicate the legal status of the operator of the facility. Indicate "public" for a facility solely owned by local government(s) such as a city, town, county, parish, etc.

Sections VII-D—H

Enter the telephone number and address of the operator identified in Item VII-A.

Section VIII

Indicate whether the facility is located on Indian lands.

Section IX

Provide a topographic map or maps of the area extending at least to one mile beyond the property boundaries of the facility which clearly show the following:

The legal boundaries of the facility;

The location and serial number of each of your existing and proposed intake and discharge structures;

All hazardous waste management facilities;

Each well where you inject fluids underground; and

All springs and surface water bodies in the area, plus all drinking water wells within ¼ mile of the facility which are identified in the public record or otherwise known to you.

If an intake or discharge structure, hazardous waste disposal site, or injection well associated with the facility is located more than one mile from the plant, include it on the map, if possible. If not, attach additional sheets describing the location of the structure, disposal site, or well, and identify the U.S. Geological Survey (or other) map corresponding to the location.

On each map, include the map scale, a meridian arrow showing north, and latitude and longitude at the nearest whole second. On all maps of rivers, show the direction of the current, and in tidal waters, show the directions of the ebb and flow tides. Use a 7-½ minute series map published by the U.S. Geological Survey, which may be obtained through the U.S. Geological Survey Offices listed below. If a 7-½ minute series map has not been published for your facility site, then you may use a 15 minute series map from the U.S. Geological Survey. If neither a 7-½ nor 15 minute series map has been published for your facility site, use a plat map or other appropriate map, including all the requested information; in this case, briefly describe land uses in the map area (e.g., residential, commercial).

You may trace your map from a geological survey chart, or other map meeting the above specifications. If you do, your map should bear a note showing the number or title of the map or chart it was traced from. Include the names of nearby towns, water bodies, and prominent points.

U.S.G.S. OFFICES	AREA SERVED
Western Mapping Center National Cartographic Information Center U.S.G.S. 345 Middlefield Road Menlo Park, Ca. 94025 Phone No. (415) 323-8111	Ariz., Calif., Hawaii, Idaho, Nev., Oreg., Wash., American Samoa, Guam, and Trust Territories

Section X

Briefly describe the nature of your business (e.g., products produced or services provided).

Section XI

For a corporation, by a principal executive officer of at least the level of vice president;

For partnership or sole proprietorship, by a general partner or the proprietor, respectively; or

For a municipality, State, Federal, or other public facility, by either a principal executive officer or ranking elected official.

FORM 1

State of Washington Department of Ecology

1301-N LWDF

DANGEROUS WASTE PERMIT GENERAL INFORMATION

(Read "Form 1 Instructions" before starting)

4/24/87, Rev. 0

WA 7 8 9 0 0 0 8 9 8

II. NAME OF FACILITY

US DEPT OF ENERGY RICHLAND OPERATIONS OFFICE

III. FACILITY CONTACT

A. NAME & TITLE (last, first, & title): FITZSIMMONS, T. R. ASSISTANT MGR SAFETY*

B. PHONE (area code & no.): 509 376 7387

IV. FACILITY MAILING ADDRESS

A. STREET OR P.O. BOX: P.O. BOX 550

B. CITY OR TOWN: RICHLAND

C. STATE: WA

D. ZIP CODE: 99352

V. FACILITY LOCATION

A. STREET, ROUTE NO. OR OTHER SPECIFIC IDENTIFIER: HANFORD SITE

B. COUNTY NAME: BENTON

C. CITY OR TOWN: RICHLAND

D. STATE: WA

E. ZIP CODE: 99352

F. COUNTY CODE (if known): 005

VI. SIC CODES (4-digit, in order of priority)

A. FIRST: 9711 (specify) NATIONAL SECURITY

B. SECOND: 8922 (specify) NUCLEAR NONCOMMERCIAL RESEARCH DEVELOPMENT AND EDUCATION

C. THIRD: 9611 (specify) ADMINISTRATION AND GENERAL ECONOMICS PROGRAM

D. FOURTH: 4911 (specify) STEAM - ELECTRIC GENERATOR

VII. OPERATOR INFORMATION

A. NAME: US DEPT OF ENERGY RICHLAND OPERATIONS

B. Is the name listed in Item VII-A also the owner? ☒ YES ☐ NO

C. STATUS OF OPERATOR (Enter the appropriate letter into the answer box; if "Other", specify.) F = FEDERAL, S = STATE, P = PRIVATE, M = PUBLIC (other than federal or state), O = OTHER (specify): F

D. PHONE (area code & no.): 509 376 7387

E. STREET OR P.O. BOX: PO BOX 550

F. CITY OR TOWN: RICHLAND

G. STATE: WA

H. ZIP CODE: 99352

VIII. INDIAN LAND

Is the facility located on Indian lands? ☐ YES ☒ NO

COMPLETE BACK PAGE

*Office of Assistant Manager for Safety, Safeguards and Quality Assurance

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EQA -275

IX. MAP

Attach to this application a topographic map of the area extending to at least one mile beyond property boundaries. The map must show the outline of the facility, the location of each of its existing and proposed intake and discharge structures, each of its hazardous waste treatment, storage, or disposal facilities, and each well where it injects fluids undergound. Include all springs, rivers and other surface water bodies in the map area. See instructions for precise requirements.

X. NATURE OF BUSINESS *(provide a brief description)*

O NATIONAL DEFENSE NUCLEAR MATERIAL PRODUCTION

O ENERGY RESEARCH AND TECHNOLOGY DEVELOPMENT

O DEFENSE NUCLEAR WASTE MANAGEMENT

O BYPRODUCT STEAM, SOLD FOR ELECTRIC POWER GENERATION

O AND SIC 15: BUILDING CONSTRUCTION - GENERAL CONTRACTORS AND OPERATIVE BUILDERS

XI. CERTIFICATION *(see instructions)*

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this application and all attachments and that, based on my inquiry of those persons immediately responsible for obtaining the information contained in the application, I believe that the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

A NAME & OFFICIAL TITLE (type or print)	B SIGNATURE	C DATE SIGNED
T.R. FITZSIMMONS, ASST. MANAGER		

ECY 030-31 Reverse

SCL 5 278-

Completing This Form

Please type or print. If you print place each character between the marks. Abbreviate if necessary to stay within the number of characters allowed for each item. Use one space for breaks between words, but not for punctuation marks unless they are needed to clarify your response.

Section I

Existing dangerous waste management facilities should enter their EPA/STATE Identification Number *(if known)*. New facilities should leave this item blank.

Section II

A FIRST APPLICATION If this is the first application that is being filed for the facility place an "X" in either the Existing Facility box or the New Facility box.

1. EXISTING FACILITY Existing facilities are:

a. Those facilities which received hazardous waste for treatment, storage, and/or disposal on or before November 19, 1980, or

b Those facilities for which construction had commenced on or before November 15, 1980. Construction had "commenced" only if

(1) The owner or operator had obtained all necessary Federal, State, and local preconstruction approvals or permits, and

(2-a) A continuous physical, on—site construction program had begun *(facility design or other preliminary non—physical and non—site specific preparatory activities do not constitute an on—site construction program)*, or

(2-b) The owner or operator had entered into contractual obligations *(options to purchase or contracts for feasibility, engineering, and design studies do not constitute contractual obligations)* which could not be cancelled or modified without substantial loss. Generally, a loss is deemed substantial if the amount an owner or operator must pay to cancel construction agreements or stop construction exceeds 10% of the total project cost.

EXISTING FACILITY DATE. If the Existing Facility box is marked, enter the date dangerous waste operations began *(i.e., the date the facility began treating, storing, or disposing of hazardous waste)* or the date construction commenced.

2. NEW FACILITY. New facilities are all facilities for which construction commenced, or will commence, after November 19, 1980.

NEW FACILITY DATE. If the New Facility box is marked, enter the date that operation began or is expected to begin.

B REVISED APPLICATION. If this is a subsequent application that is being filed to amend data filed in a previous application, place an "X" in the appropriate box to indicate whether the facility has interim status or a permit.

1 FACILITY HAS AN INTERIM STATUS PERMIT. Place an "X" in this box if this is a revised application to make changes at a facility during the interim status period.

2. FACILITY HAS A FINAL PERMIT. Place an "X" in this box if this is a revised application to make changes at a facility for which a permit has been issued.

(NOTE When submitting a revised application, applicants must resubmit in their entirety each item on the application for which changes are requested. In addition, Items I and IX [and Item X if applicable] must be completed. It is not necessary to resubmit information for other items that will not change).

Section III

The information in Section III describes all the processes that will be used to treat, store, or dispose of dangerous waste at the facility. The design capacity of each process must be provided as part of the description. The design capacity of injection wells and landfills at existing facilities should be measured as the remaining, unused capacity. See the form for the detailed instructions to Section III.

Section IV

The information in Section IV describes all the dangerous wastes that will be treated, stored, or disposed at the facility. In addition, the processes that will be used to treat, store, or dispose of each waste and the estimated annual quantity of each waste must be provided See the form for the detailed instructions to Section IV.

Section V

All existing facilities must include a drawing showing the general layout of the facility. This drawing should be approximately to scale and fit in the space provided on the form. This drawing should show the following:

The property boundaries of the facility;

The areas occupied by all storage, treatment, or disposal operations that will be used during interim status;

The name of each operation. *(Example—multiple hearth incinerator, drum storage area, etc.);*

Areas of past storage, treatment, or disposal operations,

Areas of future storage, treatment, or disposal operations, and

The approximate dimensions of the property boundaries and all storage, treatment, and disposal areas.

Section VI

All existing facilities must include photographs that clearly delineate all existing structures; all existing areas for storing, treating, or disposing of hazardous waste; and all known sites of future storage, treatment, or disposal operations. Photographs may be color or black and white, ground-level or aerial. Indicate the date the photograph was taken on the back of each photograph.

Section VII

Enter the latitude and longitude of the facility in degrees, minutes, and seconds. For larger facilities, enter the latitude and longitude at the approximate mid-point of the facility. You may use the map you provided for Section IX of Form 1 to determine latitude and longitude. Latitude and longitude information is also available from Regional Offices of the U.S. Department of Interior, Geological Survey and from State agencies such as the Department of Natural Resources.

Section VIII

See the form for the instructions to Section VIII.

Section IX and Section X

All facility owners must sign Section IX. If the facility will be operated by someone other than the owner, then the operator must sign Section X. Federal regulations require the certification to be signed as follows:

A. For a corporation, by a principal executive officer at least the level of vice president;

B. For a partnership or sole proprietorship, by a general partner or the proprietor, respectively; or

C. For a municipality, State, Federal, or other public facility, by either a principal executive officer or ranking elected official.

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Please print or type in the unshaded areas only
(fill—in areas are spaced for one type, i.e., 12 characters/inch).

1301-N LWDF

4/24/87, Rev. 0

FORM 3

DANGEROUS WASTE PERMIT APPLICATION

I. EPA/STATE I.D. NUMBER: W A 7 8 9 0 0 0 8 9 6 7

FOR OFFICIAL USE ONLY

APPLICATION APPROVED	DATE RECEIVED (mo., day, & yr.)	COMMENTS

II. FIRST OR REVISED APPLICATION

Place an "X" in the appropriate box in A or B below (mark one box only) to indicate whether this is the first application you are submitting for your facility or a revised application. If this is your first application and you already know your facility's EPA/STATE I.D. Number, or if this is a revised application, enter your facility's EPA/STATE I.D. Number in Section I above.

A. FIRST APPLICATION (*place an "X" below and provide the appropriate date*)

☒ 1. EXISTING FACILITY (*See instructions for definition of "existing" facility. Complete item below.*)

☐ 2. NEW FACILITY (*Complete item below.*)

MO.	DAY	YR.	FOR EXISTING FACILITIES, PROVIDE THE DATE (mo., day, & yr.) OPERATION BEGAN OR THE DATE CONSTRUCTION COMMENCED (use the boxes to the left)
0 3	0 1	6 4	

MO.	DAY	YR.	FOR NEW FACILITIES, PROVIDE THE DATE (mo., day, & yr.) OPERATION BEGAN OR IS EXPECTED TO BEGIN

B. REVISED APPLICATION (*place an "X" below and complete Section I above*)

☐ 1. FACILITY HAS AN INTERIM STATUS PERMIT

☐ 2. FACILITY HAS A FINAL PERMIT

III. PROCESSES — CODES AND DESIGN CAPACITIES

A. PROCESS CODE — Enter the code from the list of process codes below that best describes each process to be used at the facility. Ten lines are provided for entering codes. If more lines are needed, enter the code(s) in the space provided. If a process will be used that is not included in the list of codes below, then describe the process (*including its design capacity*) in the space provided on the (*Section III-C*).

B. PROCESS DESIGN CAPACITY — For each code entered in column A enter the capacity of the process.

1. AMOUNT — Enter the amount.
2. UNIT OF MEASURE — For each amount entered in column B(1), enter the code from the list of unit measure codes below that describes the unit of measure used. Only the units of measure that are listed below should be used.

PROCESS	PROCESS CODE	APPROPRIATE UNITS OF MEASURE FOR PROCESS DESIGN CAPACITY
Storage:		
CONTAINER (barrel, drum, etc.)	S01	GALLONS OR LITERS
TANK	S02	GALLONS OR LITERS
WASTE PILE	S03	CUBIC YARDS OR CUBIC METERS
SURFACE IMPOUNDMENT	S04	GALLONS OR LITERS
Disposal:		
INJECTION WELL	D80	GALLONS OR LITERS
LANDFILL	D81	ACRE-FEET (*the volume that would cover one acre to a depth of one foot*) OR HECTARE-METER
LAND APPLICATION	D82	*ACRES OR HECTARES*
OCEAN DISPOSAL	D83	GALLONS PER DAY OR LITERS PER DAY
SURFACE IMPOUNDMENT	D84	GALLONS OR LITERS

PROCESS	PROCESS CODE	APPROPRIATE UNITS OF MEASURE FOR PROCESS DESIGN CAPACITY
Treatment:		
TANK	T01	GALLONS PER DAY OR LITERS PER DAY
SURFACE IMPOUNDMENT	T02	GALLONS PER DAY OR LITERS PER DAY
INCINERATOR	T03	TONS PER HOUR OR METRIC TONS PER HOUR; GALLONS PER HOUR OR LITERS PER HOUR
OTHER (Use for physical, chemical, thermal or biological treatment processes not occurring in tanks, surface impoundments or incinerators. Describe the processes in the space provided; Section III-C.)	T04	GALLONS PER DAY OR LITERS PER DAY

UNIT OF MEASURE	UNIT OF MEASURE CODE
GALLONS	G
LITERS	L
CUBIC YARDS	Y
CUBIC METERS	C
GALLONS PER DAY	U
LITERS PER DAY	V
TONS PER HOUR	D
METRIC TONS PER HOUR	W
GALLONS PER HOUR	E
LITERS PER HOUR	H
ACRE-FEET	A
HECTARE-METER	F
ACRES	B
HECTARES	Q

EXAMPLE FOR COMPLETING SECTION III (*shown in line numbers X-1 and X-2 below*): *A facility has two storage tanks, one tank can hold 200 gallons and the other can hold 400 gallons. The facility also has an incinerator that can burn up to 20 gallons per hour.*

LINE NUMBER	A. PROCESS CODE (*from list above*)	B. PROCESS DESIGN CAPACITY 1. AMOUNT (*specify*)	B. PROCESS DESIGN CAPACITY 2. UNIT OF MEASURE (*enter code*)	FOR OFFICIAL USE ONLY	LINE NUMBER	A. PROCESS CODE (*from list above*)	B. PROCESS DESIGN CAPACITY 1. AMOUNT (*specify*)	B. PROCESS DESIGN CAPACITY 2. UNIT OF MEASURE (*enter code*)	FOR OFFICIAL USE ONLY
X-1	S 0 2	600	G		5				
X-2	T 0 3	20	E		6				
1	D 8 5	4,320,000	U		7				
2					8				
3					9				
4					10				

Continued from the front

III. PROCESSES (continued)

SPACE FOR ADDITIONAL PROCESS CODES OR FOR DESCRIBING OTHER PROCESS (code "T04"). FOR EACH PROCESS ENTERED HERE INCLUDE DESIGN CAPACITY.

D85; The 1301-N Liquid Waste Disposal Facility made use of the natural adsorption, precipitation, and ion exchange which occurred in the soil column to reduce the concentration of radioactive materials in the waste stream discharged to the facility. Liquid wastes entered the facility via a concrete trough, than flowed into a crib and discharge trench where they percolated into the soil column.

The 1301-N LWDF also historically received small volumes of radioactive mixed wastes. These radioactive mixed wastes were discharged to the LWDF via the N-Reactor radioactive drain system, and comprised less than 0.0002% of the total volume of wastes discharged to the facility. Administrative and physical controls are currently in place to prevent the future discharge of any hazardous wastes to the LWDF, and the facility will be closed under interim status.

IV. DESCRIPTION OF DANGEROUS WASTES

A. DANGEROUS WASTE NUMBER — Enter the four digit number from Chapter 173-303 WAC for each listed dangerous waste you will handle. If you handle dangerous wastes which are not listed in Chapter 173-303 WAC, enter the four digit number(s) that describes the characteristics and/or the toxic contaminants of those dangerous wastes.

B. ESTIMATED ANNUAL QUANTITY — For each listed waste entered in column A estimate the quantity of that waste that will be handled on an annual basis. For each characteristic or toxic contaminant entered in column A estimate the total annual quantity of all the non—listed waste(s) that will be handled which possess that characteristic or contaminant.

C. UNIT OF MEASURE — For each quantity entered in column B enter the unit of measure code. Units of measure which must be used and the appropriate codes are:

ENGLISH UNIT OF MEASURE	CODE	METRIC UNIT OF MEASURE	CODE
POUNDS	P	KILOGRAMS	K
TONS	T	METRIC TONS	M

If facility records use any other unit of measure for quantity, the units of measure must be converted into one of the required units of measure taking into account the appropriate density or specific gravity of the waste.

D. PROCESSES

1. PROCESS CODES:

For listed dangerous waste: For each listed dangerous waste entered in column A select the code(s) from the list of process codes contained in Section III to indicate how the waste will be stored, treated, and/or disposed of at the facility.

For non—listed dangerous wastes: For each characteristic or toxic contaminant entered in Column A, select the code(s) from the list of process codes contained in Section III to indicate all the processes that will be used to store, treat, and/or dispose of all the non—listed dangerous wastes that possess that characteristic or toxic contaminant.

Note: Four spaces are provided for entering process codes. If more are needed: (1) Enter the first three as described above; (2) Enter "000" in the extreme right box of item IV-D(1); and (3) Enter in the space provided on page 4, the line number and the additional code(s).

2. PROCESS DESCRIPTION: If a code is not listed for a process that will be used, describe the process in the space provided on the form.

NOTE: DANGEROUS WASTES DESCRIBED BY MORE THAN ONE DANGEROUS WASTE NUMBER — Dangerous wastes that can be described by more than one Waste Number shall be described on the form as follows:

1. Select one of the Dangerous Waste Numbers and enter it in column A. On the same line complete columns B, C, and D by estimating the total annual quantity of the waste and describing all the processes to be used to treat, store, and/or dispose of the waste.
2. In column A of the next line enter the other Dangerous Waste Number that can be used to describe the waste. In column D(2) on that line enter "included with above" and make no other entries on that line.
3. Repeat step 2 for each other Dangerous Waste Number that can be used to describe the dangerous waste.

EXAMPLE FOR COMPLETING SECTION IV *(shown in line numbers X-1, X-2, X-3, and X-4 below)* — A facility will treat and dispose of an estimated 900 pounds per year of chrome shavings from leather tanning and finishing operation. In addition, the facility will treat and dispose of three non—listed wastes. Two wastes are corrosive only and there will be an estimated 200 pounds per year of each waste. The other waste is corrosive and ignitable and there will be an estimated 100 pounds per year of that waste. Treatment will be in an incinerator and disposal will be in a landfill.

LINE	A. DANGEROUS WASTE NO. (enter code)	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE (enter code)	D. PROCESSES 1. PROCESS CODES (enter)	D. PROCESSES 2. PROCESS DESCRIPTION (if a code is not entered in D(1))
X-1	K 0 5 4	900	P	T 0 3 D 8 0	
X-2	D 0 0 2	400	P	T 0 3 D 8 0	
X-3	D 0 0 1	100	P	T 0 3 D 8 0	
X-4	D 0 0 2			T 0 3 D [illegible]	included with above

OLSC -271- ECY 030-31 Form 3

CONTINUE ON PAGE 3

Continued from page 2
NOTE. Photocopy this page before completing if you have more than 26 wastes to list.

I.D. NUMBER (enter from page 1)
WA 7 8 9 0 0 0 8 9 6 7

IV. DESCRIPTION OF DANGEROUS WASTES (continued)

LINE NO.	A. DANGEROUS WASTE NO. (enter code)	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE (enter code)	D. PROCESSES 1. PROCESS CODES (enter)	D. PROCESSES 2. PROCESS DESCRIPTION (if a code is not entered in D(1))
1	F003	6,129	P	D85	
2	D002				Included with above
3	WT02	6,129	P	D85	
4	D002				Included with above
5	D009				Included with above
6	WT02	7,794	P	D85	
7	D002				Included with above
8	D007	10,000	P	D85	
9	D002	630	P	D85	
10	D008				Included with above
	D002	270	P	D85	
12	D006				Included with above
13	U133	350	P	D85	
14	WC02	3,897	P	D85	
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					

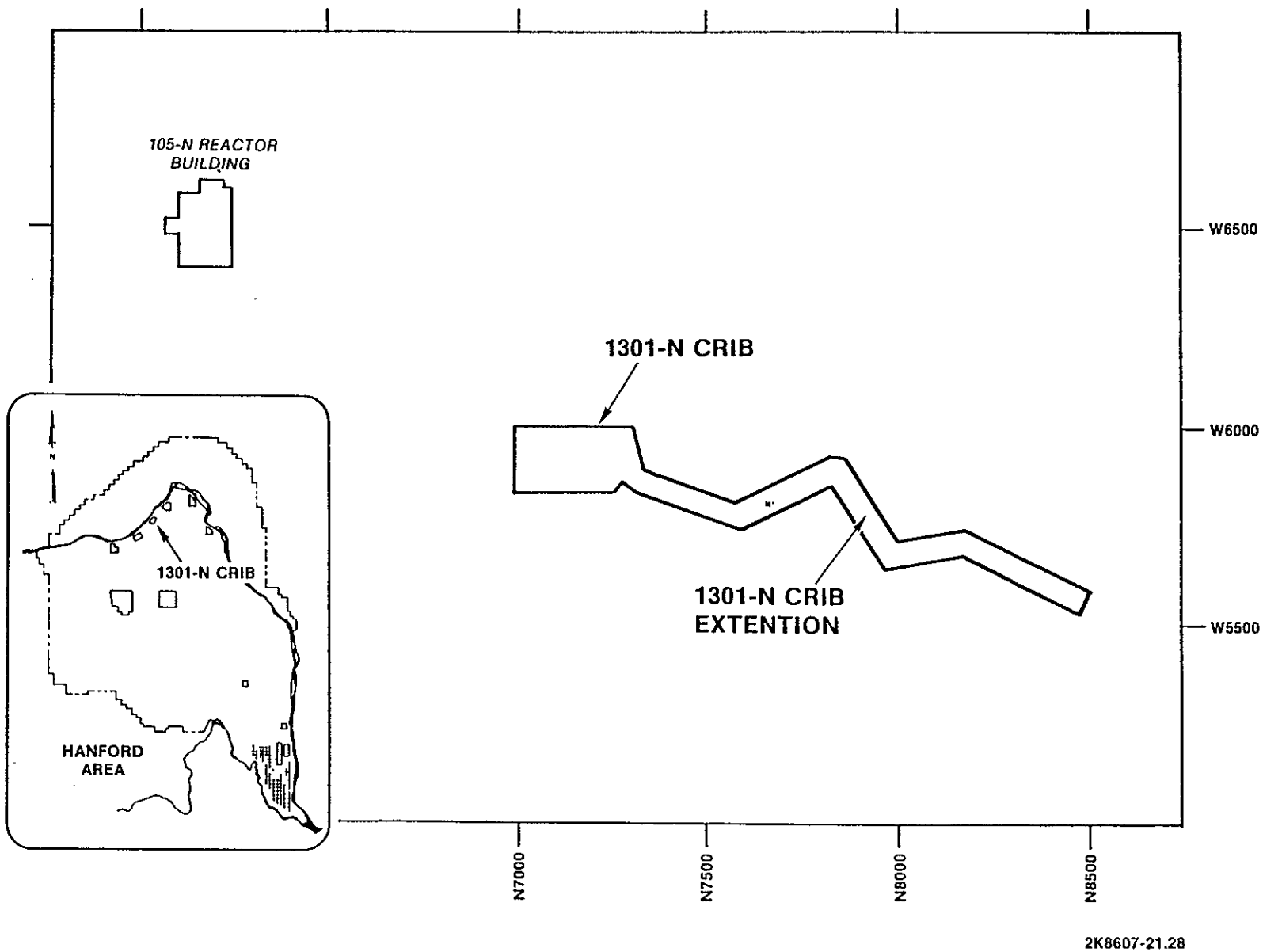
ECL30 -271- ECY 030-31 Form 3

(enter "A", "B", "C" or identify photocopied pages)

CONTINUE ON REVERSE

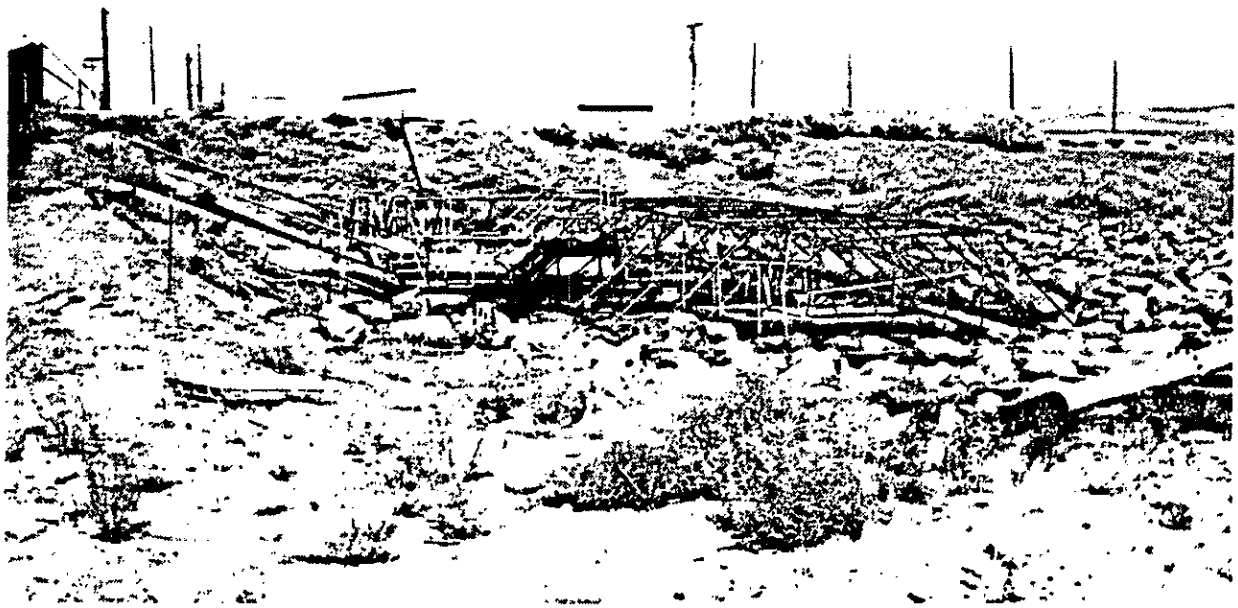
SECTION V - FACILITY DRAWINGS

1301-N CRIB

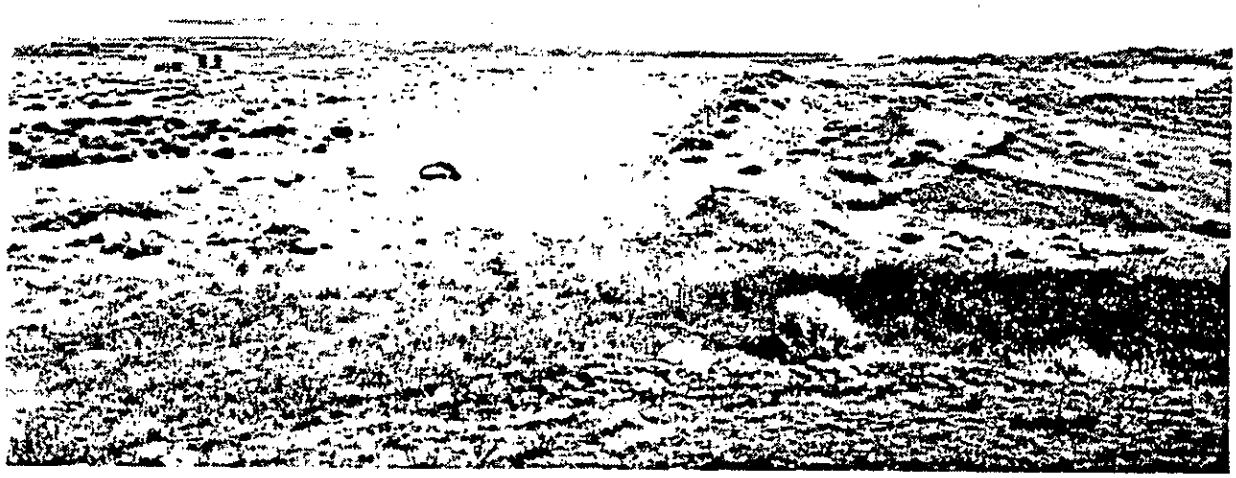

105-N REACTOR BUILDING
1301-N CRIB
1301-N CRIB EXTENTION
HANFORD AREA
1301-N CRIB
W6500
W6000
W5500
N7000
N7500
N8000
N8500
2K8607-21.28

SECTION VI - PHOTOGRAPHS

1301-N LIQUID WASTE FACILITY



CRIB OUTFALL



TRENCH CONCRETE COVER

(PHOTO TAKEN 1986)

Longitude	Latitude
119° 33' 48.867"	46° 40' 36.334"

2K8607-21.26

2.0 FACILITY DESCRIPTION

This section provides a general description of the hazardous waste management facility being described in this closure/post-closure plan. This description is intended to provide the permit application reviewer/permit writer with an overview of the Hanford Site and this facility. More complete details on this facility can be found in other parts of this closure plan.

2.1 GENERAL DESCRIPTION

The Hanford site is a 570 square mile tract of semi-arid land which is owned and operated by the U.S. Department of Energy. This site is located northwest of the city of Richland, Washington in the Columbia Basin. The city of Richland lies approximately three miles from the southern-most portion of the Hanford Site boundary and is the nearest population center (see Figure 2-1). In early 1943, the United States Army Corps of Engineers selected the Hanford Site as the location for reactor, chemical separation, and related facilities and activities for the production and purification of plutonium. A total of eight graphite-moderated reactors using Columbia River water for once-through cooling were built along the Columbia River. These reactors were operated from 1944 to 1971. N Reactor is a different type of dual-purpose reactor used to produce plutonium and generate steam for the production of electricity. N Reactor began operating in 1963 and remains in operation today. N Reactor is cooled with a recirculating water coolant.

Activities are centralized in numerically designated areas on the Hanford Site. The reactor facilities (active and decommissioned) are located along the Columbia River in what are known as the 100 Areas. The reactor fuel processing and waste management facilities are in the 200 Areas which are on a plateau about seven miles from the river. The 300 Area, located north of Richland, contains the reactor fuel manufacturing facilities and the research and development laboratories. The 400 Area, five miles northwest of the 300 Area, contains the Fast Flux Test Facility (FFTF). The 1100 Area, north of Richland, contains facilities associated with maintenance and transportation functions for the Hanford Site. Administrative buildings and

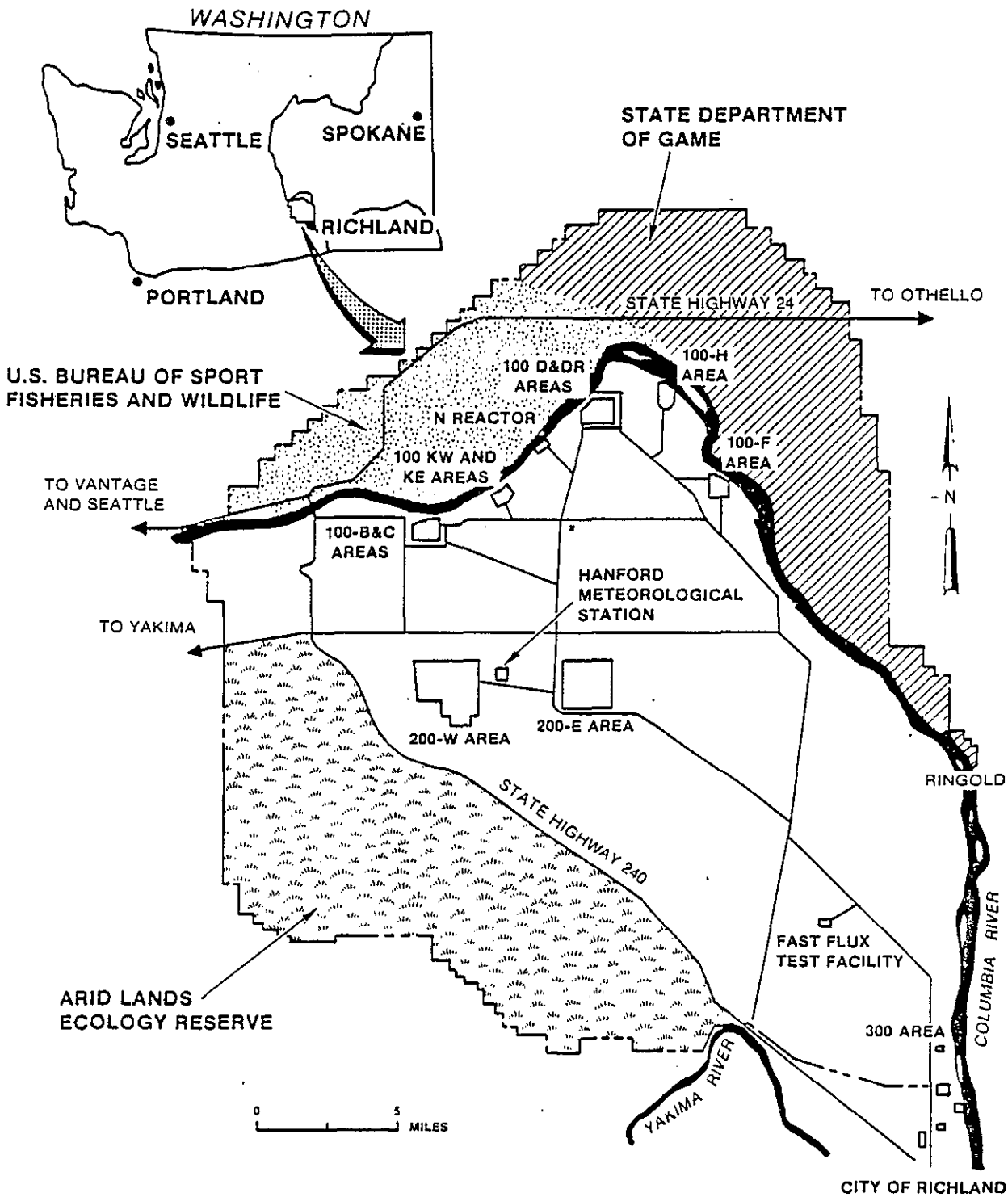


FIGURE 2-1
SURROUNDING LAND USE

other research and development laboratories are found in the 3000 Area, also located north of Richland. The Nonradioactive Dangerous Waste Landfill is located two miles southeast of the 200 East Area in the 600 Area of the Hanford Site. The Nonradioactive Dangerous Waste Storage Facility is located between the 200 East and 200 West Areas on Route 3S, which is also located in the 600 Area.

The 1301-N Liquid Waste Disposal Facility is a newly identified disposal facility which historically received hazardous wastes. A brief description of this facility follows:

1301-N Liquid Waste Disposal Facility

The 1301-N Liquid Waste Disposal Facility (LWDF) located at the 100-N Area of the Hanford Site (see Figure 2-2) was the primary liquid radioactive waste disposal system for the N Reactor until September 1985. Use of the facility began at the time of reactor startup in 1963.

The facility is located approximately 60 feet above and 860 feet east of the shore of the Columbia River. The original facility consisted of a 52-foot by 12-foot concrete trough (weir box) and a 125-foot by 290-foot rectangular basin (crib). The crib was constructed by excavating existing soil and then surrounding the excavation with a soil and gravel embankment. The bottom of the crib was filled with a 3-foot layer of large stones.

After only a few years of reactor operation an extension trench was added to the crib. The trench is an excavated ditch approximately 1600 feet long, 50 feet wide, and 12 feet deep, extending in a zigzag pattern. In 1982, the trench was covered with precast concrete panels to exclude mammals, birds, reptiles, etc. from contact with the wastes.

2.2 TOPOGRAPHIC MAPS

The first map in Appendix A is a general overview map of the entire Hanford Site property and the surrounding countryside. It is intended to be used as a location map and illustrates the following:

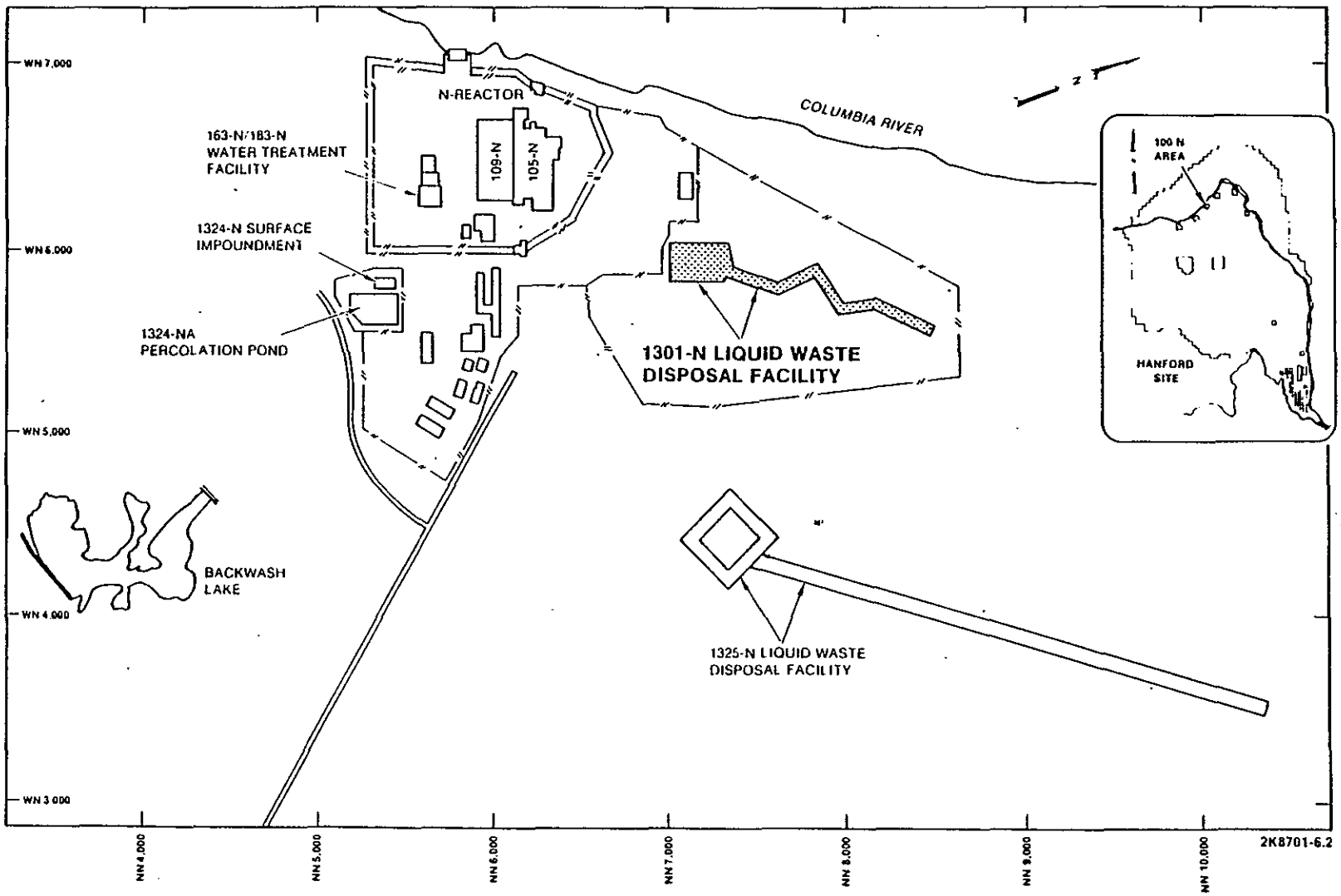


FIGURE 2-2
100-N AREA FACILITIES

- The facility boundary, which for purposes of this closure/post-closure plan is defined as those portions of the Hanford Site located within the perimeter security fences shown on the map;

- Surrounding land use including the Saddle Mountain National Wildlife Refuge and the State Game Reserve to the north and the Rattlesnake Mountain Ecological Reserve located to the west. Land east of the Hanford Site across the Columbia River is primarily farmland or a part of the Game Reserve. The surrounding land area is also shown in Figure 2-1 of this closure/post-closure plan;

- Contours sufficient to show surface water flow. Because of the area shown, contours are 20 foot spacing;

- Fire control facilities located on the Hanford Site;

- Locations of access roads, internal roads, railroads, and perimeter gates and barricades; and

- Longitudes and latitudes.

Appendix A also contains a topographic map of the 100-N Area of the Hanford Site. This map indicates the location of the 1301-N Liquid Waste Disposal Facility. This map is drawn to a scale of 1" = 100', and the contours are 2-foot spacing. The locations of the 100-N Area hazardous waste management units are also shown on this map.

Figure 2-5 illustrates the wind rose data for various locations on the Hanford Site. The winds on the Hanford Site are predominately from the west.

Figure 2-2 shows the general layout of the 100-N Area of the Hanford Site, and the location of the hazardous waste management units in the 100-N Area.

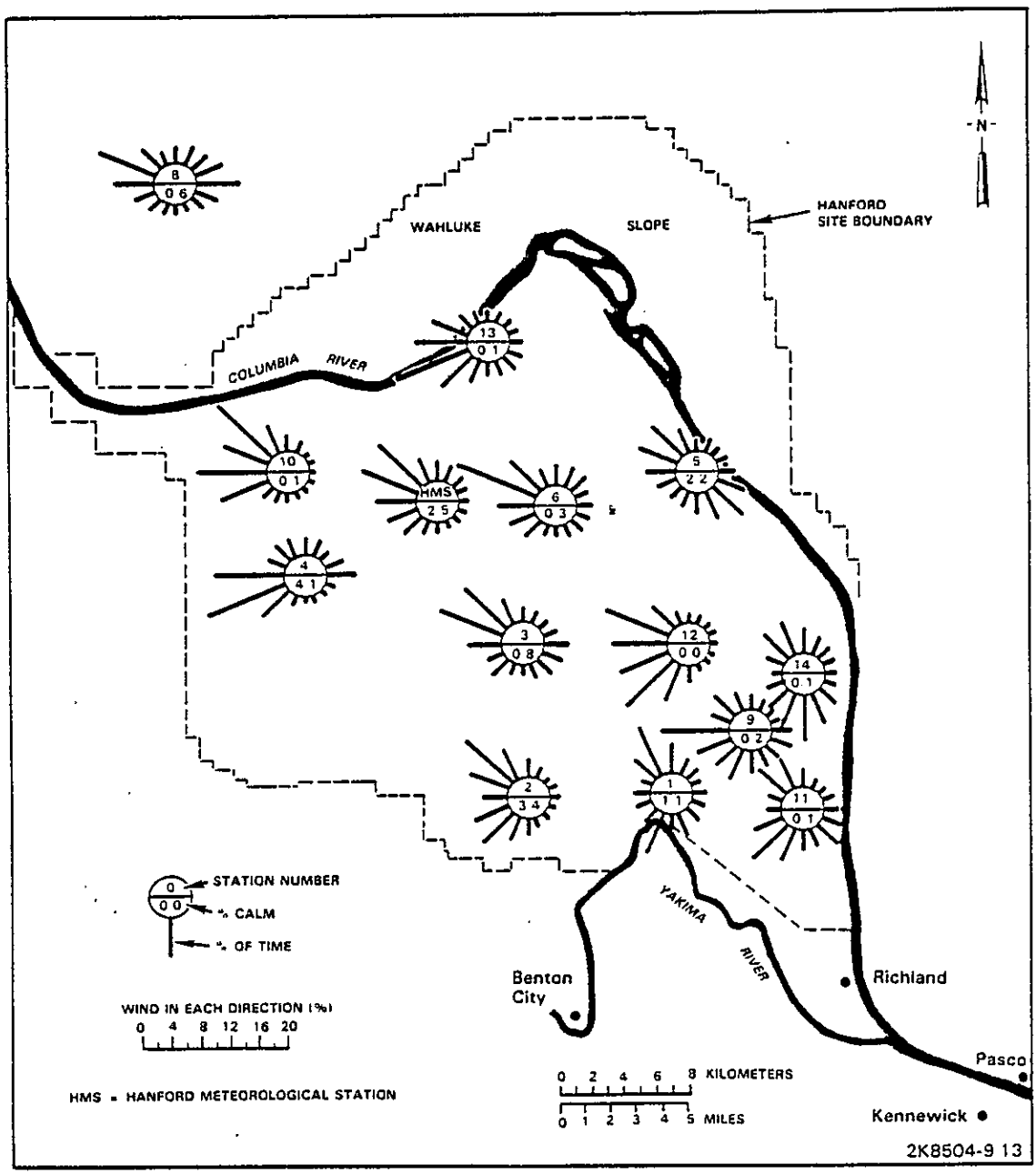


FIGURE 2-5
WIND ROSE DATA FOR THE HANFORD TELEMETRY NETWORK

A water table contour map of the uppermost aquifer showing the groundwater flow directions for the Hanford Site Facilities is also located in Appendix A. Further hydrology and geology information is discussed in Section 5.0 of this Closure/Post-Closure Plan.

2.3 LOCATION INFORMATION

Seismic Consideration

The DOE Hanford Site is not located within any of the political jurisdictions identified in Appendix VI of 40 CFR 264 or WAC 173-303-420(3)(C) which are considered to be seismically active. Therefore, no further information is required to demonstrate compliance with the seismic standard.

Floodplain Standard

The Army Corp of Engineers (Jamison, 1982) has calculated the probable maximum flood based on the upper limit of precipitation falling on a drainage area and other hydrologic factors such as antecedent moisture conditions, snowmelt, and tributary conditions that could lead to maximum runoff. The probable maximum flood for the Columbia River below Priest Rapids Dam has been calculated to be 1.4 million cubic feet/second. The floodplain associated with the probable maximum flood is shown in Figure 2-4. The inundated area shown in Figure 2-4 is greater than that which would be inundated during a 100 year flood. The facilities addressed in this Closure/Post-Closure Plan are located above the 100-year floodplain.

2.4 TRAFFIC INFORMATION

Travel on roadways inside the Hanford Site is restricted to authorized personnel and cannot be accessed by the general public. The majority of traffic inside the Hanford Site boundaries consists of light duty vehicles and buses used to transport the employees to the various operations sites located within the Hanford Site.

Figure 2-3 shows the major roads throughout the Hanford Site. These roads are classified as either primary or secondary routes. The primary routes include Routes 4S, 10, 4N and the portion of 11A east of route 4N. All other roads

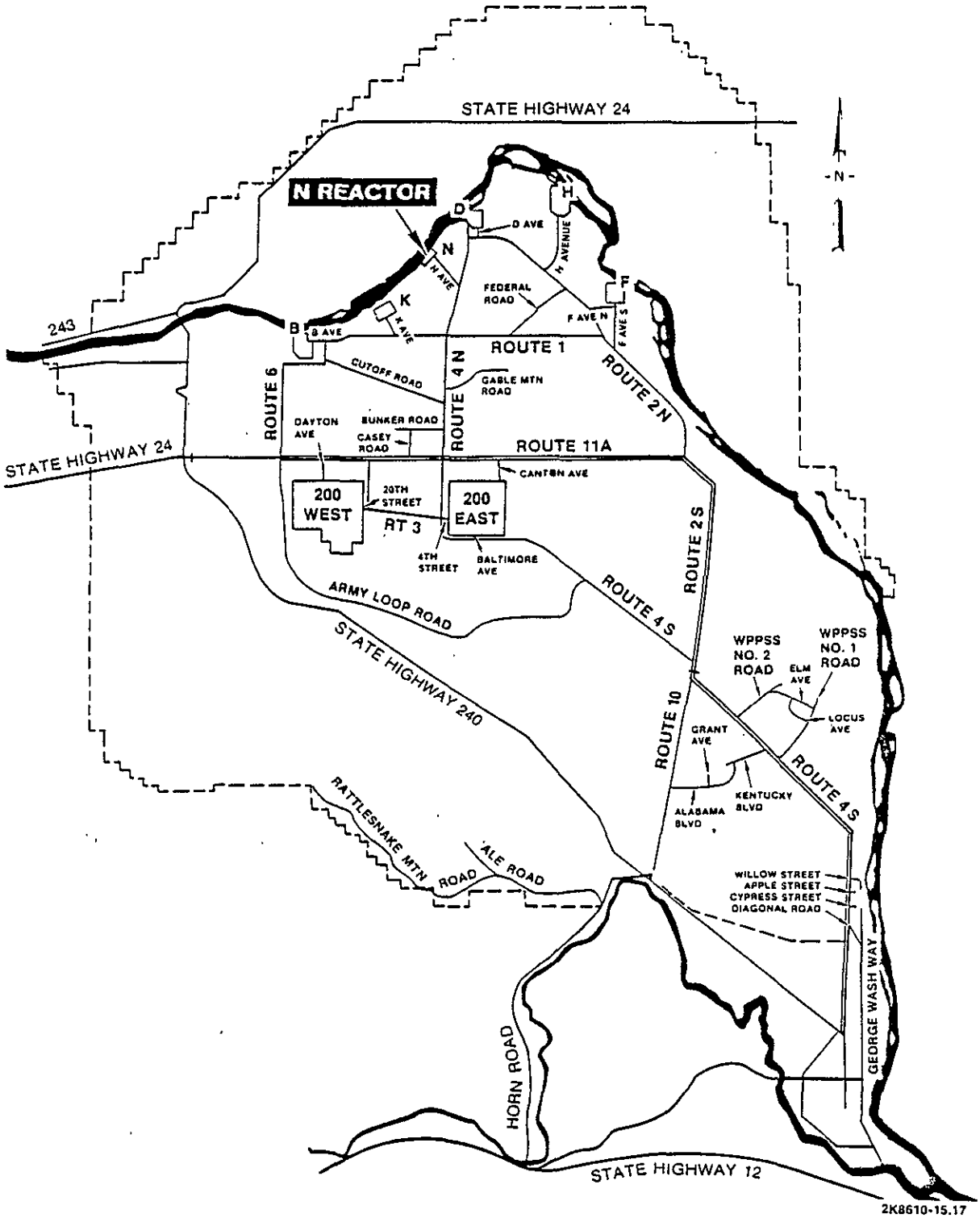


FIGURE 2-3
HANFORD SITE ROADS

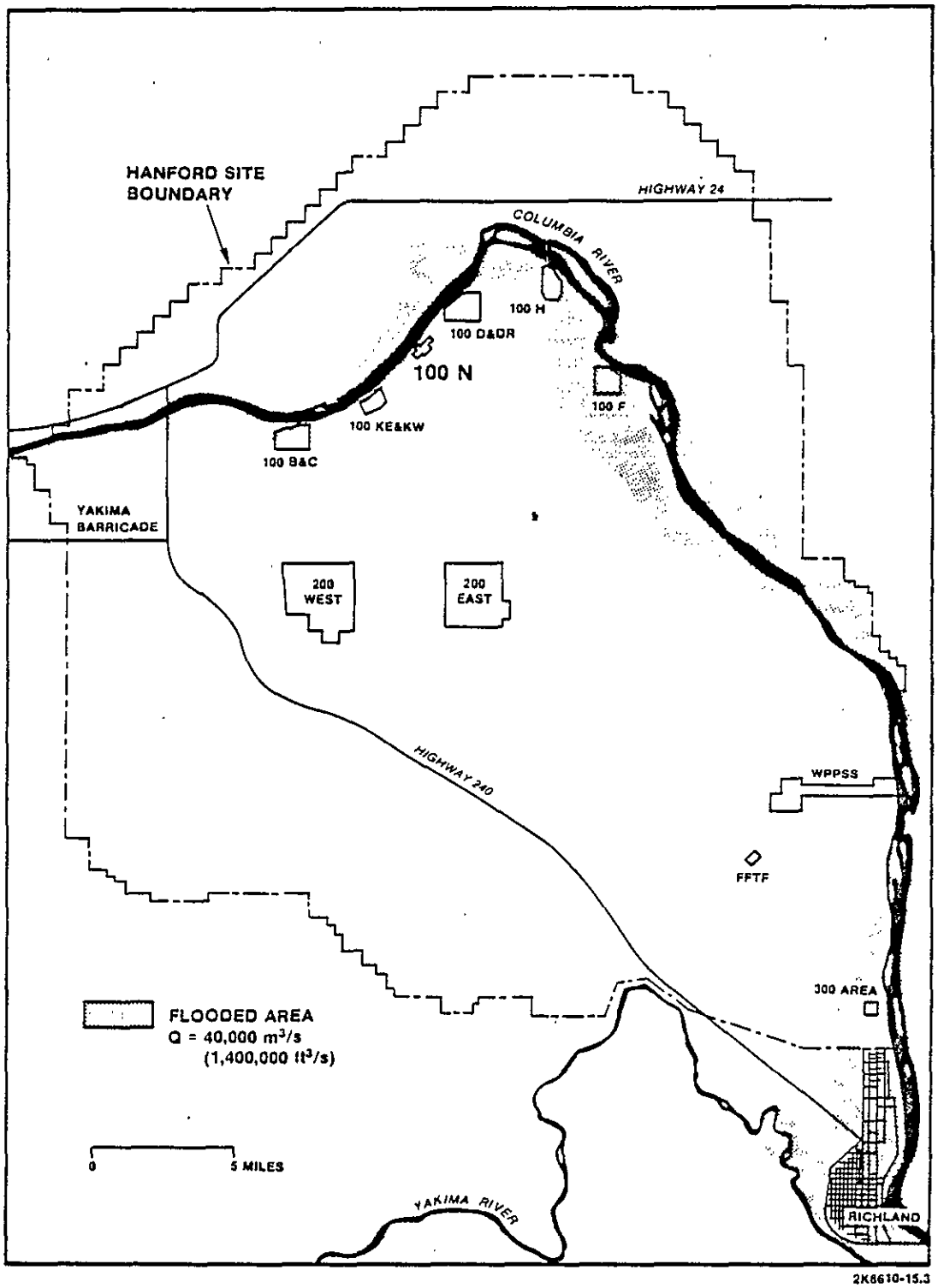


FIGURE 2-4
PROBABLE MAXIMUM FLOOD AREA

are secondary routes. The primary routes are bituminous asphalt (usually two inches thick, but the thickness of the asphalt layer will vary with each road) with an underlying aggregate base. The secondary routes are constructed of layers of an oil and rock mixture with an underlying aggregate base. The aggregate base consists of various types and sizes of rock found on site.

The 1301-N LWDF is located within the Hanford Controlled Access Area where roadways cannot be accessed by the general public. This facility is isolated from the nearest public highway, State Highway 24, by at least four miles.

The 1301-N LWDF is located approximately one-quarter mile northwest of the Hanford Site highway which is used by site personnel traveling to the 100-N Area. The roads leading to the 1301-N LWDF are constructed of soil materials with an underlying aggregate base. Emergency vehicles would be routed to the facility via the dirt roads. The facility is surrounded by a perimeter chain link fence with two access roads and locking gates.

All wastes were carried from their point of generation to the 1301-N LWDF via one of the three waste transfer lines entering the facility. Vehicle traffic around the facility is restricted and is minimal since the area is fenced and marked as a radiation zone.

2.5 REFERENCES

Jamison, J. P., "Standardized Format for Hanford Environmental Impact Statements," PNL-3509 PT2, 1982.

3.0 WASTE CHARACTERISTICS

3.1 INFLUENT TO 1301-N LWDF

The wastes which were disposed of in the 1301-N Liquid Waste Disposal Facility (LWDF) were generated in the 105-N Reactor and 109-N Heat Exchanger Buildings. Waste streams routed to the 1301-N LWDF were:

- Reactor coolant system bleed off.
- Spent fuel storage basin cooling water overflow.
- Reactor periphery cooling systems bleed off.
- Reactor primary coolant loop decontamination rinse solution.
- Building drains containing radioactive wastes generated from reactor support facilities.

The combination of the above waste streams resulted in an average flow of approximately 1,700 gallons per minute to the 1301-N LWDF. Sampling conducted on the influent to the 1301-N LWDF (see Table 3-1) did not exhibit any of the characteristics of a dangerous waste nor did it identify any designated dangerous wastes listed in WAC 173-303 at the point of discharge into the 1301-N LWDF.

3.2 REACTOR PRIMARY COOLANT SYSTEM

The reactor primary coolant system is supplied by demineralized water with chemicals added for water quality control. The chemicals which are introduced into the primary coolant system are ammonium hydroxide and hydrazine. Ammonium hydroxide is used for pH control and is injected at a concentration of approximately 40 ppm to maintain a pH of 10.2 to 10.4 standard units. Hydrazine is introduced for oxygen control at a concentration of 0.04 ppm.

TABLE 3-1
1301-N LIQUID WASTE DISPOSAL FACILITY WASTE ANALYSIS

PARAMETER (MDL)	SAMPLE 1	2	3	AVERAGE
pH (standard units)	6.58	6.56	6.97	6.70
Conductivity (micromhos)	148	155	190	164
Mercury (.001 ppm)	LD	LD	LD	LD
Ethylene glycol (10 ppm)	LD	LD	LD	LD
Enhanced thiourea (.2 ppm)	LD	LD	LD	LD
TOC (1 ppm)	.00184	.00200	.00205	.00197
Cyanide (.01 ppm)	LD	LD	LD	LD
Barium (.006 ppm)	.030	.027	.027	.028
Cadmium (.002 ppm)	LD	LD	LD	LD
Chromium (.01 ppm)	LD	LD	LD	LD
Lead (.03 ppm)	LD	LD	LD	LD
Silver (.01 ppm)	LD	LD	LD	LD
Sodium (.1 ppm)	1.831	1.819	1.781	1.810
Nickel (.01 ppm)	LD	LD	LD	LD
Copper (.01 ppm)	LD	LD	LD	LD
Vanadium (.005 ppm)	LD	LD	LD	LD
Antimony (.1 ppm)	LD	LD	LD	LD
Aluminum (.15 ppm)	LD	LD	LD	LD
Manganese (.005 ppm)	LD	LD	LD	LD
Potassium (.1 ppm)	.647	.608	.606	.620
Iron (.05 ppm)	.081	.077	.050	.069
Beryllium (.005 ppm)	LD	LD	LD	LD
Osmium (.3 ppm)	LD	LD	LD	LD
Strontium (.3 ppm)	LD	LD	LD	LD
Zinc (.005 ppm)	LD	LD	LD	LD
Calcium (.05 ppm)	14.400	13.970	14.050	14.140
Nitrate (.5 ppm)	LD	LD	LD	LD
Sulphate (.5 ppm)	12.416	11.532	11.970	11.973
Fluoride (.5 ppm)	LD	LD	LD	LD
Chloride (.5 ppm)	1.578	1.478	1.533	1.530
Phosphate (1 ppm)	LD	LD	LD	LD
Phosphorus Pesticides (.005 ppm)	LD	LD	LD	LD
Chlorinated Pesticides (.001 ppm)	LD	LD	LD	LD
Enhanced ABN List	LD	LD	LD	LD
Citrus Red (1 ppm)	LD	LD	LD	LD
Arsenic (.005 ppm)	LD	LD	LD	LD
Ammonium Ion (.05 ppm)	LD	LD	LD	LD
Coliform (3 MPN)	---	.023	.009	.016
Selenium (.005 ppm)	LD	LD	LD	LD
Thallium (.01 ppm)	LD	LD	LD	LD

LD = Less Than Detectable
MDL = Minimum Detection Limit
Data obtained from samples taken August, 1985.

Normal operation of the reactor primary coolant system results in approximately 200 gpm of bleed off and leakage which was discharged to the 1301-N LWDF. Concentration of chemicals used in maintaining the water quality of the primary coolant system were very low at the point of discharge to the 1301-N LWDF. Their influence was non-detectable and the stream did not exhibit any of the characteristics of a dangerous waste due to these chemicals.

3.3 FUEL STORAGE BASIN COOLING WATER

The spent fuel storage basin is supplied by filtered water with chlorine added as an algicide. A trace amount of residual chlorine is maintained to assure complete treatment. The overflow does not contain hazardous chemical constituents and therefore had no impact on the dangerous waste classification of wastes discharged to the 1301-N LWDF.

3.4 REACTOR PERIPHERY COOLING SYSTEMS

Reactor periphery cooling systems, which discharged bleed off wastes to the 1301-N LWDF, included:

- Graphite and shield cooling.
- Reactor control rod cooling.
- Reactor secondary coolant loop.

As with other reactor cooling systems, bleed off and spillage from the periphery cooling systems resulted in small continuous discharges to the 1301-N LWDF. Sampling conducted on the 1301-N LWDF influent (see Table 3-1) indicates that the flow from these streams has no impact on the dangerous waste classification of wastes discharged to the 1301-N LWDF.

3.4a Graphite and Shield Cooling

The graphite and shield cooling system is supplied by demineralized water with chemicals added for water quality control. Ammonium hydroxide is injected at

a concentration of approximately 40 ppm to maintain a pH of 10.0 to 10.2 standard units. Hydrazine is injected for oxygen control at a concentration of 0.04 ppm.

3.4b Reactor Control Rod Cooling

The reactor control rod cooling system is a recirculating system supplied by demineralized water with chemicals added for water quality control. Ammonium hydroxide is injected at a concentration of approximately 40 ppm to maintain a pH of 7.0 standard units. Hydrazine is injected for oxygen control at a concentration of 0.15 ppm. Historically, sodium dichromate was added to this system at a concentration of 10 ppm for corrosion control; however, this practice was discontinued in the early 1970s.

3.4c Reactor Secondary Coolant Loop

The reactor secondary coolant loop is supplied by demineralized water with chemicals added for water quality control. Morpholine is injected at a concentration of approximately 4 ppm to maintain a pH of 8.6 to 9.2 standard units. Hydrazine is injected for oxygen control at a concentration of no greater than 1 ppm.

3.5 REACTOR PRIMARY COOLANT LOOP DECONTAMINATION

A decontamination of the reactor primary coolant loop is performed once each 2 to 4 years as necessary. The decontamination solution is comprised of 21,000 gallons TURCO 4512-A (70% phosphoric acid) and 300 to 400 pounds of diethylthiourea. This solution is diluted to an eight weight percent phosphoric acid solution as it enters the reactor coolant loop.

The decontamination solution and concentrate rinse were disposed of through a system separate from the 1301-N LWDF using a radioactive waste tank. After the pH of the rinsate had been verified to be between 6.0 and 9.0 standard units, the final rinse solution containing approximately 100,000 gallons of demineralized water was discharged to the 1301-N LWDF.

Wastes received at the 1301-N LWDF from the reactor decontamination were extremely dilute (approximately one ten thousandth of the original concentration of the decontamination wastes). The calculated phosphoric acid which was released to the 1301-N LWDF per decontamination was 1.5 gallons and the calculated amount of diethylthiourea was 2.3 grams. The decontamination rinse solution was not designated a hazardous waste since the concentrations of the chemical constituents were extremely low when the rinsate was diverted to the 1301-N LWDF.

3.6 BUILDING DRAINS

The radioactive drain system is a network of floor drains which collects radioactive water from throughout the 109-N and 105-N Buildings. Pump leakage, and system bleed off from the reactor primary and periphery cooling systems were transported to the 1301-N LWDF via this system. Other contributing streams to the radioactive drain system are:

- Laboratories which performed chemical analyses on reactor cooling water.
- Auxiliary power battery lockers.
- Floor drain in the hydrazine mixing and injection area.

Of the wastes discarded to the radioactive drain system, three have exhibited characteristics of a dangerous waste. These are, leaks and spills from the auxiliary power battery lockers, spills of hydrazine from hydrazine mixing and injection facilities, and wastes generated from chemical analyses performed in reactor support laboratories. Each of these wastes, at their point of introduction into the radioactive drain system, contained contaminants which are designated dangerous wastes under WAC 173-303-090. However, sampling conducted on the 1301-N LWDF influent (see Table 3-1) has not identified any of the characteristics of a dangerous waste at the point of discharge of the waste stream into the 1301-N LWDF.

3.6a Wastes from Chemical Analyses

Chemical analyses are performed in the laboratories to determine the amount of hydrazine, ammonia, chloride, and fluoride in the reactor coolant loop water. Waste characterization has indicated that the solutions discarded from these tests contain constituents which are designated as dangerous wastes under WAC 173-303-090.

Historically these solutions were discarded to the radioactive drain system which discharges to the 1301-N LWDF. However, all of these solutions are now containerized and disposed of as per regulations.

3.6b Auxiliary Power Battery Lockers

Spills and leaks from the auxiliary power battery lockers contributed 50 to 100 gallons per year of waste from lead-acetate and nickel-cadmium batteries. It is estimated that approximately 70 percent of the spilled material was from lead-acetate batteries and 30 percent from nickel-cadmium batteries.

Satellite accumulation areas have been established to receive wastes generated from maintenance activities in the battery lockers. The wastes are containerized and packaged for disposal as per regulations outlined in WAC 173-303-200. Administrative controls have been put into effect to preclude the discarding of these wastes to the floor drains.

3.6c Floor Drain in the Hydrazine Mixing and Injection Area

Hydrazine spills from mixing and injection activities occasionally entered the radioactive drain system. Spills in this area were very small in volume and in the case of the mixed solution were extremely dilute. It is estimated that a maximum of 350 pounds per year of hydrazine were spilled in this manner. This area has been curbed and isolated from the building drain, thus allowing spills to be contained, cleaned up and disposed of as per regulations.

WP #9139A

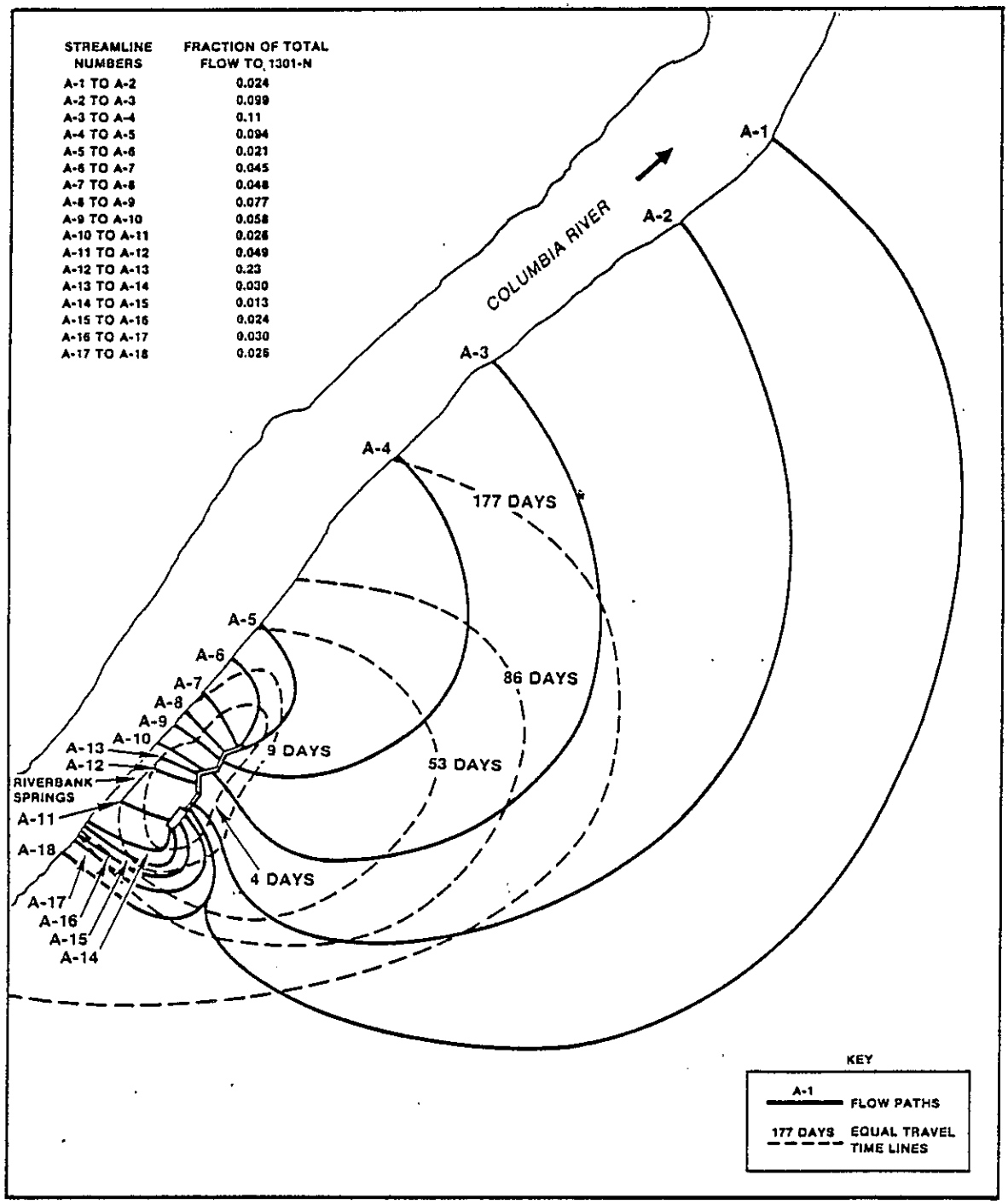
4.0 PROCESS INFORMATION

The 1301-N Liquid Waste Disposal Facility (LWDF) was the primary liquid radioactive waste disposal system for the N Reactor until September 1985. Use of the facility began at the time of reactor start-up in 1963.

The original facility consisted of a 52-foot by 12-foot concrete trough (weir box) and a 125-foot by 290-foot rectangular basin (crib). The crib was constructed by excavating existing soil then surrounding the excavation with a soil and gravel embankment. The bottom of the crib was filled with a 3-foot layer of large stones. After a few years of reactor operation an extension trench was added to the crib. The trench is an excavated ditch approximately 1600 feet long, 50 feet wide, and 12 feet deep, extending in a zigzag pattern. In 1982, the trench was covered with precast concrete panels to exclude mammals, birds, reptiles, etc. The drawing in Appendix B shows a plan view of the 1301-N LWDF as it exists presently.

The 1301-N LWDF was a ground disposal facility that made use of the natural filtration properties of soil to remove radioactive and hazardous materials from liquid radioactive wastes. All of the wastes were carried from their point of generation to the 1301-N LWDF via one of the three waste transport lines entering the facility. As discharged liquids percolated through the soil column, radioactive materials and hazardous constituents were retained in the soil by filtration, adsorption and ion exchange.

Hydrological analyses of the area underlying the 1301-N LWDF have indicated that flow pathways to the Columbia River are a complex system where the water may have entered the river from beneath the river bed or from springs on the river shoreline, and that the pathways may have led directly to the river, or may have paralleled the river for several miles before entry into the river (see Figure 4-1). Radionuclide sampling studies have shown that the most radioactive spring water entered the river via the shortest crib-to-river pathway.



2K8701-6.37

FIGURE 4-1
CALCULATED FLOW PATHS ORIGINATING FROM
THE 1301-N FACILITY WITH TRAVEL TIME LINES

Monitoring of the river shoreline springs which contained the majority of the flow from the 1301-N LWDF is provided for under the Hanford Site National Pollutant Discharge Elimination System (NPDES) Permit No. WA-000374-3. This NPDES monitoring measures the influence that discharges from the facility have had on the surrounding ground water system. The current permit requires monitoring of oil and grease, iron, ammonia and chromium concentrations, and the temperature of the springs. Outfall characterization completed during the original permit application period indicated that no other chemical or physical parameters were influenced to a degree which would warrant further monitoring activities.

In support of a radioactive waste management plan a closure/post-closure plan addressing the radiological concerns of the facility was developed and is included in Appendix C. Radiological stabilization of the facility will be accomplished in an environmentally accepted manner.

The 1301-N LWDF is currently out of service and administrative controls assure that no routine wastes will be discharged to the facility. However, if an accident were to occur that would overload the distribution system leading to the new 1325-N LWDF, the non regulated wastes being transported via the radioactive drain system may inadvertently be routed to the 1301-N LWDF. These routine wastes are non-regulated since all sources of hazardous wastes have been identified and are now either being containerized or have been isolated from entering the radioactive drain system.

A project scheduled to be completed in June 1987, will provide an alternate means of impoundment for emergency flow, and prevent overflow to the 1301-N LWDF. The completion of this project will ensure that hazardous wastes will no longer be disposed of in the 1301-N LWDF even during accidents.

WP #9143A

5.0 GROUNDWATER MONITORING

5.1 EXEMPTION FROM GROUND WATER PROTECTION REQUIREMENTS

This section is not applicable as DOE-RL is not proposing to apply for an exemption from ground water protection requirements at the 1301-N Liquid Waste Disposal facility.

5.2 INTERIM STATUS GROUND WATER MONITORING DATA

No ground water monitoring program for hazardous waste constituents is currently in place, therefore no interim status ground water monitoring data exists. Since 1964 the ground water near the 1301-N facility has been monitored for the presence of gamma-emitting radionuclides. Section 5.5 describes the proposed ground water monitoring program for hazardous chemical constituents. Data obtained from this ground water monitoring will be submitted to the Department of Ecology or EPA to satisfy the requirements for interim status ground water monitoring as soon as such data are available.

5.3 REGIONAL HYDROGEOLOGY AND AQUIFER IDENTIFICATION

5.3a Hydrogeologic Setting

Ground water has been monitored on the Hanford site since the 1940's. While the main purpose of this monitoring was to track the movement of radionuclides in the ground water, analysis of these ground water monitoring data provides a sound overall view of the hydrogeology of the Hanford site.

This hydrogeologic information gathered from years of ground water monitoring was used to identify the uppermost aquifer and underlying hydraulically connected aquifers, and to establish ground water flow direction and rate at the site of the 1301-N Liquid Waste Disposal Facility.

As a preface to the required discussion of the hydrogeologic properties underlying the 1301-N Liquid Waste Disposal Facility, the total regional and local meteorologic, geologic, and hydrologic properties of the Hanford Site

are presented. The following is a summary of this information. This information was gathered from the the documents listed in Appendix D. If more information is desired, these reports are available upon request.

Meteorological data are collected at a number of locations at the Hanford Site. Complete climatological data are available since 1945 for the Hanford Meteorological Station (HMS), located approximately five miles (eight kilometers) south of the 100-N Area. Temperature and precipitation data from the old Hanford Townsite are available for the period 1912 through 1943, which is located approximately 3 miles downriver from N Reactor (Stone, et. al., 1983).

Average monthly temperatures at HMS range from a low of 29.3 degrees Fahrenheit (-1.5 degrees Centigrade) in January to a high of 76.4 degrees Fahrenheit (24.7 degrees Centigrade) in July. The maximum monthly average temperature at the HMS during the winter is 44.5 degrees Fahrenheit (6.9 degrees Centigrade), and the minimum is 21.4 degrees Fahrenheit (-5.9 degrees Centigrade), both occurring during February. The maximum monthly average temperature at HMS during the summer is 81.8 degrees Fahrenheit (27.7 degrees Centigrade) in July, and the minimum is 63.0 degrees Fahrenheit (17.2 degrees Centigrade) in June. The annual average relative humidity at the HMS is 54 percent, with a maximum of about 75 percent during the winter months and a minimum of about 35 percent during the summer months.

Average annual precipitation at the Hanford Meteorological Station is 6.3 inches (16 centimeters). The months of November through February account for nearly one-half of the annual precipitation. Fewer than one percent of the days have rainfall greater than 0.5 inches (1.3 centimeters). The maximum 24-hour rainfall event in a 100-year period was predicted to be 2.0 inches (5 centimeters) (Stone, et. al., 1983). Total precipitation over the entire Pasco Basin is estimated at less than 8 inches (20 centimeters) annually. Mean annual run-off is generally less than 0.5 inches (1.3 centimeters) for most of the basin and the basin-wide run-off coefficient, for all practical purposes, is zero (Leonhart, 1979).

Average annual evaporation on the Hanford Site can exceed 60 inches (152 centimeters). Average annual lake evaporation ranges from approximately 39 to over 42 inches (99 to over 107 centimeters). Actual evapotranspiration for a 6-inch (15-centimeter) water-holding-capacity soil (uncultivated) is approximately 7.5 to 8.5 inches (19 to 22 centimeters) (Leonhart, 1979; Wallace, 1978). Studies by Last et. al. (1976), Brown and Isaacson (1977), and Jones (1978) suggest that much of the percolated water is subsequently dispersed by evapotranspiration.

In summary, the Hanford climate is mild and dry with occasional periods of high winds. Summers are hot and dry; winters are less dry, but are relatively mild for this latitude. Average maximum temperatures occur in July, and average minimum temperatures occur in February. Average relative humidity is lowest in the summer and highest in the winter. Average annual precipitation is about 6.3 inches (16 centimeters). The 100-year maximum predicted rainfall event in a 24-hour period is 2.0 inches (5 centimeters). Potential evapotranspiration rates greatly exceed annual precipitation rates, but much of this precipitation is received between November and February when evapotranspiration rates are least. The highest monthly average winds occur during the hot summer, creating higher evaporative potentials.

5.3b Regional Geologic Setting

5.3b(1) Introduction

The Hanford Site in south-central Washington State is located in the Columbia Plateau Physiographic Province, which is generally defined by a thick accumulation of a basaltic lava flows. These flows extend laterally from central Washington eastward into Idaho and southward into Oregon (Figure 5-1). Deformation of these lava flows has formed a series of broad structural and topographic basins. The Hanford Site is located in one of these basins, the Pasco Basin, at the confluence of the Yakima and Columbia Rivers.

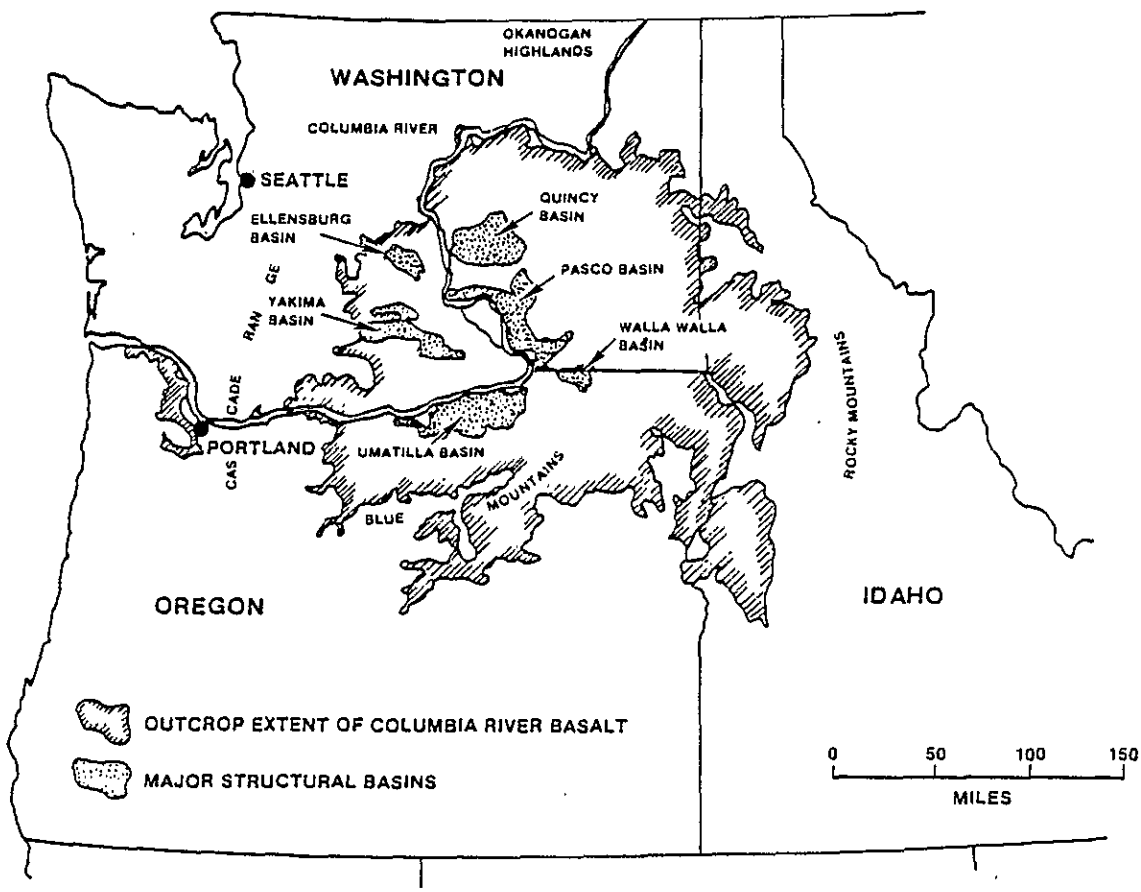


FIGURE 5-1
GEOGRAPHIC EXTENT OF THE COLUMBIA RIVER BASALT GROUP

The Pasco Basin is bounded on the north by the Saddle Mountains; on the west by Umptanum Ridge, Yakima Ridge, and the Rattlesnake Hills; on the south by a series of doubly plunging anticlines which merge with the Horse Heaven Hills; and on the east by a broad monocline, locally known as the Jackass Mountain Monocline (Figure 5-2). Very little topographic relief exists within the Pasco Basin.

The stratigraphy underlying the Pasco Basin is divided into six major units. They are, in general ascending order: (1) the basement rocks, (2) the Columbia River Basalt Group, (3) the Ellensburg Formation, (4) the Ringold Formation, (5) the early "Palouse" soil, and (6) the Hanford Formation. Alluvium, colluvium and eolian sediments locally veneer the surface of the Pasco Basin. These six units are described below.

5.3b(2) Basement Rocks

The basement rocks underlying the basaltic lava flow in the Pasco Basin are of uncertain composition. Pre-basalt rock types can be projected from the margins of the Columbia Plateau, 100 to 150 miles (160 to 240 kilometers) away, and are inferred to exist locally in the central plateau area, perhaps beneath the Pasco Basin. For example, data from the Basalt Explorer Well northeast of the Pasco Basin indicate that sandstones and shales comparable to the sedimentary rocks of the Cascade Range may lie beneath the Pasco Basin. Recent magnetotelluric surveys indicate a very deep conductive section, possibly representing these sediments (BWIP, 1978). Beneath these sediments are probably granitic rocks comparable to those in the Okanogan Highlands; the Snoqualmie Pass area of the Cascade Range; the Moscow Basin, Idaho; the base of the Basalt Explorer Well; and parts of the core of the Blue Mountains, Oregon. There, granitic rocks were intruded into largely Paleozoic and early Mesozoic metavolcanic and metasedimentary rocks whose equivalents might also occur beneath the Pasco Basin.

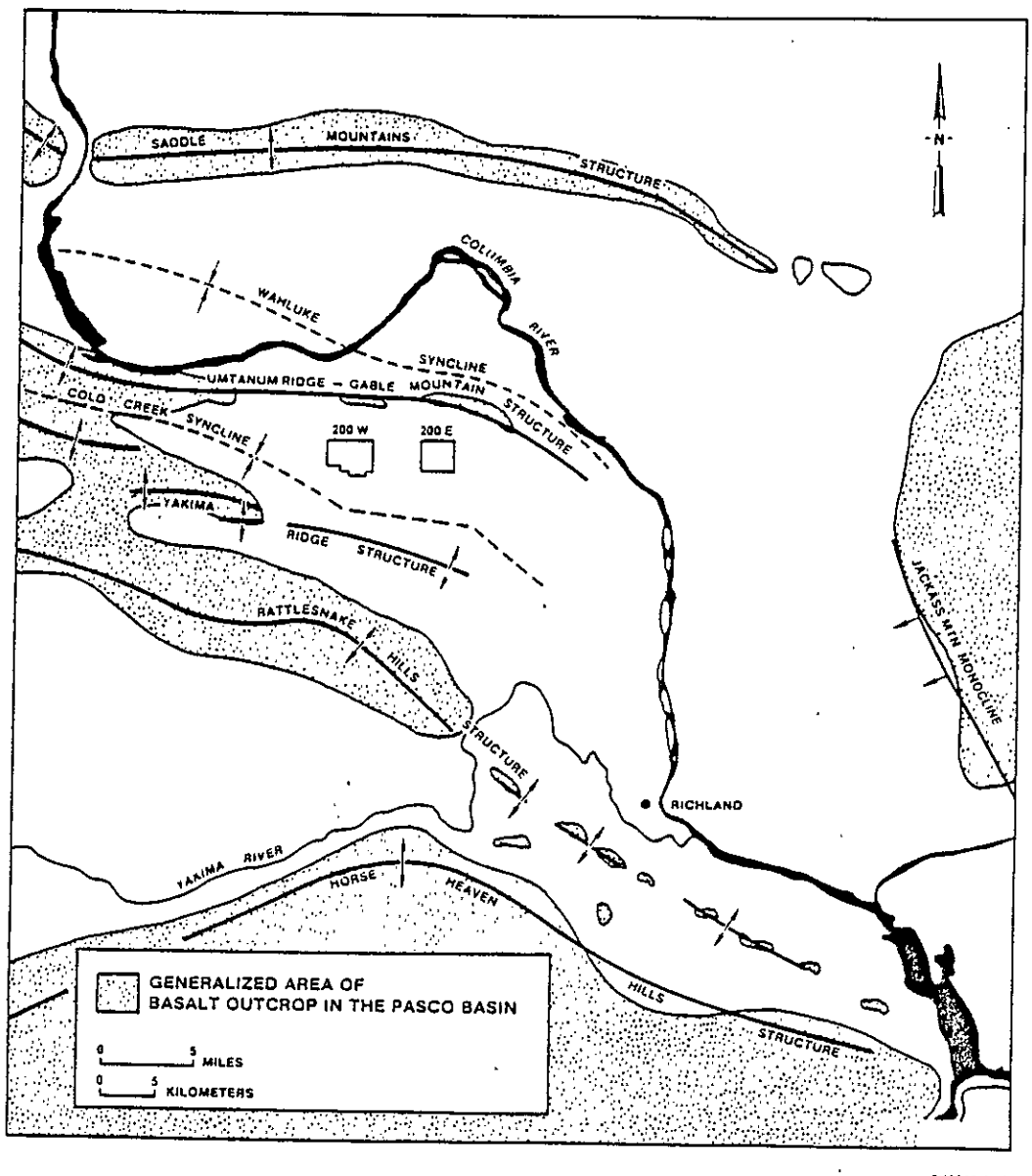


FIGURE 5-2
STRUCTURAL GEOLOGY OF THE PASCO BASIN

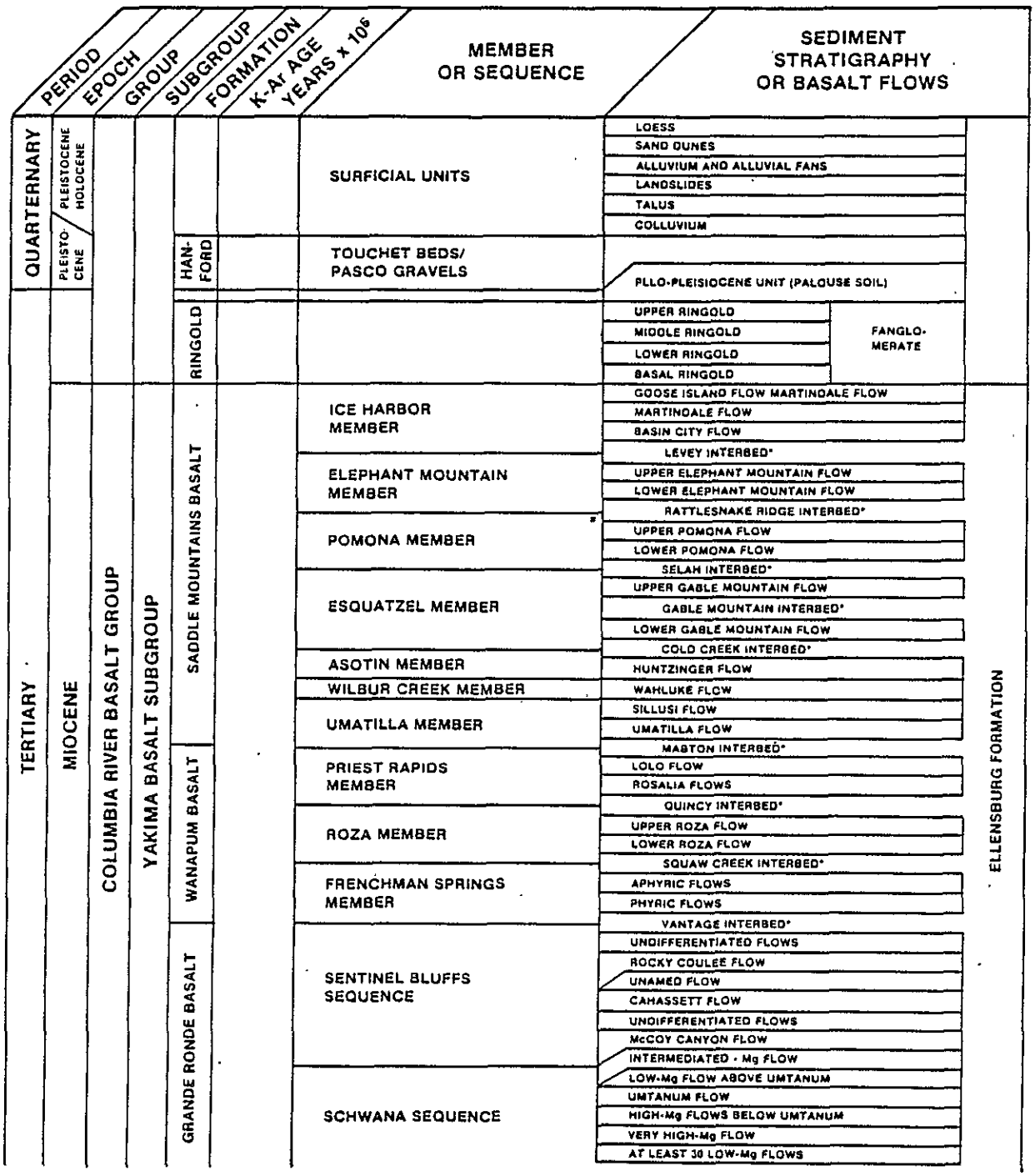
5.3b(3) Columbia River Basalt Group

The regional geology surrounding the Pasco Basin is dominated by a tholeitic flood basalt province in the Columbia Plateau and adjacent Blue Mountains of Washington, northern Oregon, and adjacent Idaho (Figure 5-1). The flood basalt province is a layered mass of more than 50,000 cubic miles (208,420 cubic kilometers) of basalt covering an area of more than 60,000 square miles (155,400 square kilometers). The flood basalts and associated rocks form a plano-convex lens. The upper surface of the lens slopes gently inward except where locally modified by fold systems (Figure 5-1). Basin deformation and the development of fold systems in the Columbia Plateau started between 16 and 13 million years before present and continued through Columbia River Basalt time (Bentley, 1977).

The basalts emanated from linear fissure systems in the eastern and southern portions of the Plateau (Swanson et. al., 1975; Walters, 1961). Most of the basalt was emplaced during a three-million-year volcanic pulse between 16 and 13 million years before present during the Miocene Epoch (Baski and Watkins, 1973). However, sporadic fissure eruptions continued until about six million years before present (McKee, et. al., 1977).

The flood basalts are collectively designated the Columbia River Basalt Group, which has been subdivided into five formations (Figure 5-3) (Ledgerwood, et. al., 1978; Swanson et. al., 1978). The lower two formations are the Imnaha Basalt (Hooper, 1974) and the Picture Gorge Basalt (Swanson et. al., 1975). The upper three formations, the Grande Ronde Basalt, the Wanapum Basalt, and the Saddle Mountains Basalt collectively constitute the Yakima Basalt Subgroup (Swanson et. al., 1978).

In the Pasco Basin near the center of the area covered by the Columbia Plateau, the basalt sequence is more than 10,000 feet (3,048 meters) thick (Raymond and Tillson, 1968) and perhaps as much as 19,000 feet (5,791 meters) thick (BWIP, 1978). In the Basin, a 5,000-foot (1,524-meter) thick sequence of Columbia River Basalt apparently overlies a series of older basalt of Oligocene to Eocene age (Swanson et. al., 1978). Approximately 100 basalt



* THE INTERBEDS ARE STRATIGRAPHICALLY CONTAINED IN THE ELLENSBURG FORMATION

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FIGURE 5-3
STRATIGRAPHIC NOMENCLATURE OF THE PASCO BASIN

flows, including both the Columbia River Basalt Group and older lavas, have been identified from geophysical logs obtained from a 10,655-foot (3,248-meter) deep borehole located along the western margin of the Pasco Basin (Swanson et. al., 1978).

5.3b(4) Ellensburg Formation

Within the upper part of the Columbia River Basalt sequence, sediments were transported into the central portion of the Columbia Plateau between basalt eruptions. These sediments, which include tuffs and tuffaceous sediments of many kinds in part now altered to clay, form the Ellensburg Formation (Swanson et. al., 1978). Many basalt flows above the Vantage sandstone interbed are capped locally by stream-deposited sediments. The extent and thickness of the sediments generally increase upward in the section.

About 1.5 million years ago, ancestral river systems were crossing central Washington, laying down trains of gravel, sand, silt, and clay comparable to today's Columbia River and Snake River sediments. As the plateau subsided, the ancestral Columbia River returned by gravity to the center of the Columbia Plateau, leaving sediment trains as a mark of its earlier courses. East of the present course of the Columbia River, sediments are virtually nonexistent between basalt flows. This attests to the fact that the ancestral Columbia River source being limited to the western half of the Columbia Plateau.

5.3b(5) Ringold Formation

Deformation during the later stages of Columbia River Basalt volcanism resulted in the emergence of the Yakima fold system in the western Plateau. Growth of these folds created a system of structural ridges and basins, which include: the Ellensburg Basin, Quincy Basin, Yakima Basin, Pasco Basin and Umatilla Basin (Figure 5-1). Thick sequences of sediments transported from the surrounding highlands accumulated in these basins.

In the Pasco Basin, the Pliocene Ringold Formation (Gustafson, 1978) was deposited in response to a flattening of the gradient of the Columbia and Snake River systems, perhaps related to the uplift of the Horse Heaven Hills (Newcomb, 1958; Newcomb et. al., 1972). The Ringold Formation in the Pasco Basin accumulated to a thickness of up to 1,200 feet (365 meters).

The Ringold Formation can generally be divided into four units on the basis of texture: sand and gravel of the basal Ringold unit; clay, silt and fine sand with lenses of gravel of the lower Ringold unit; occasionally cemented sand and gravel of the middle Ringold unit; and silt and fine sand of the upper Ringold unit (Brown, 1959) (Figures 5-3 and 5-4).

The basal portion of the Ringold Formation is, in general, conformable with the surface of the underlying basalt bedrock. The lower Ringold unit is thickest in the central portion of the Pasco Basin and thins to the basin's margins. The matrix supported conglomerate of the middle Ringold unit overlies the lower unit. The upper Ringold unit is generally confined to the margins of the basin; elsewhere, it either was not deposited, or has been eroded by ancestral river systems and by Pliestocene catastrophic flooding of the basin.

5.3b(6) Early "Palouse" Soil

An eolian silt and fine sand (loess) overlie part of the eroded surface of the Ringold Formation in the western part of the Hanford Site (Brown, 1970) (Figures 5-3 and 5-4). Elsewhere, the silt was not deposited or was eroded during Pliestocene catastrophic flooding. The silt is considered to be the equivalent of early loesses of the Palouse Hills in eastern Washington and western Idaho. It indicates a climate comparable to that of today, with effective wind transport and deposition of sediment.

5.3b(7) Hanford Formation

The Ringold Formation and the basalts and sedimentary interbeds were locally eroded and truncated by multiple floods that occurred as ice-dammed lakes released catastrophic torrents of water and ice when the ice dams were

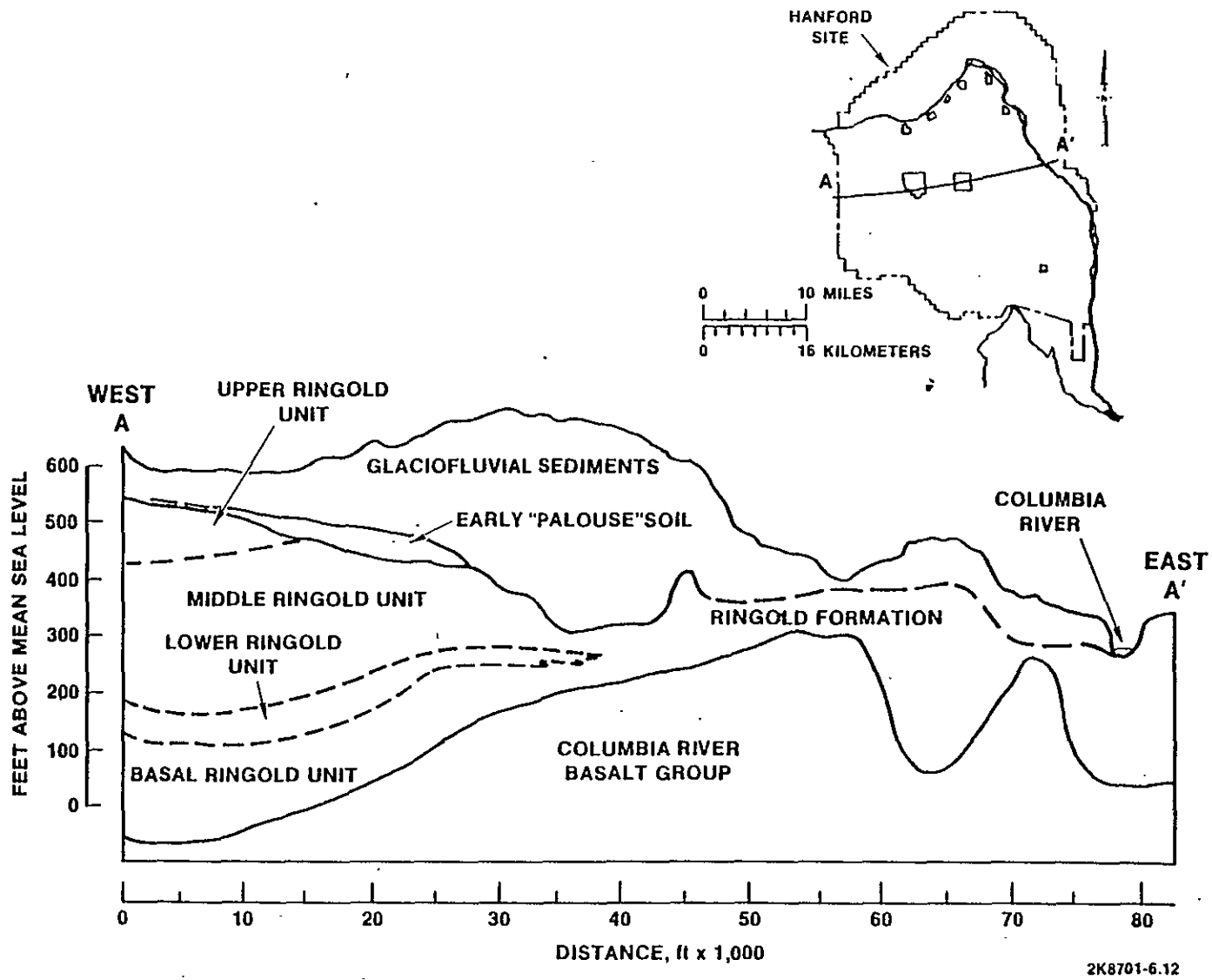

FIGURE 5-4
GENERALIZED GEOLOGIC CROSS SECTION THROUGH THE HANFORD SITE

breached during Pliestocene glaciation (Bretz, 1959; Baker, 1973; Fecht and Tallman, 1978). The floods scoured the land surface, leaving a network of buried channels crossing the Pasco Basin.

The glaciofluvial sediments in the Pasco Basin, informally named the Hanford Formation, were deposited on the Columbia River Basalt Group and Ringold Formation (Figures 5-3 and 5-4). These sediments can be divided into the coarser sand and gravel which are referred to as the Pasco Gravels (Brown, 1975), and the finer sand and silt units called the Touchet Beds (Flint, 1938).

The Touchet Beds represent low-energy (slackwater) sediments deposited in Glacial Lake Lewis, which formed when flood waters were backed up behind the Wallula Gap constriction (Flint, 1938). The Pasco Gravels represent high energy deposition in areas of more rapid water flow. In general, the Touchet Beds are found on the margins of the basin and the Pasco Gravels in and near the center of the basin. The characteristic variability of sediment size and degree of sorting within the "gravel" unit can be attributed to changes in water velocity and water level which occurred during the flooding process. The thickness of the Hanford Formation varies significantly within the basin, with the thickest occurrence in the region of buried channels.

5.3b(8) Eolian Deposits

Loess and sand dunes mantle the surface of the Pasco Basin (Lillie, et. al., 1978). These deposits are primarily reworked sediments of the Hanford Formation from surrounding areas. The thickness of the wind-blown sediments varies considerably, ranging from zero to more than 30 feet (9 meters) in some dunes.

The land surface has been only slightly modified since the deposition of the Hanford Formation. Eolian erosion and deposition have resulted in minor deflation and deposition of sand and silt veneers up to 25 feet (8 meters) thick.

5.3c Geology of the 100-N Area

Since 1984, fourteen new wells (N-36 through N-53) were drilled in an area east and northeast of the 1301-N Liquid Waste Disposal Facility. Study of these wells provides general geologic information on the 100-N Area. Figure 5-5 shows the location of the 100 Area wells.

The 1301-N facility is located on glacial outwash gravels, which are referred to as the Hanford Formation. These gravels are poorly sorted and are the result of ice that was carried by the Columbia River during the ice age and deposited in the area. The resulting "kame and kettle" topography is formed when the ice melted away, leaving the irregular topography. These gravels are about 20 feet thick. Underlying the Hanford Formation is the upper Ringold sands and gravels which were deposited in a manner which exibits deltaic bedding. The upper Ringold sand and gravels are underlain by clay which is about 425 feet thick and overlies the Columbia River Basalt Group (Figure 5-4). The top of the clay layer is considered to be the bottom of the unconfined aquifer in this area. Figure 5-6 is a diagrammatic sketch of the geology of the area.

Examination of the geophysical logs provided additional information on the sediments penetrated by the new wells. In particular, the natural gamma logs for all ten wells indicated (by a marked deflection to the right) the presence of a relatively thick layer with a high silt content (Figure 5-7). Although present in all of the wells, the character of the silty deposit varies slightly from well to well. For example, in well 199-N-42, the natural gamma log indicates the presence of a series of thin, silty layers interbedded with more sandy/gravelly layers, while the log of well 199-N-38 indicates the presence of one thick silty layer.

After this silty deposit was identified in the geophysical logs, the drilling samples were re-examined. In general there was a higher percentage of silt in the samples from the interval in which the deflection occurred on the logs. Thus, the interpretation of the geophysical logs was verified by the

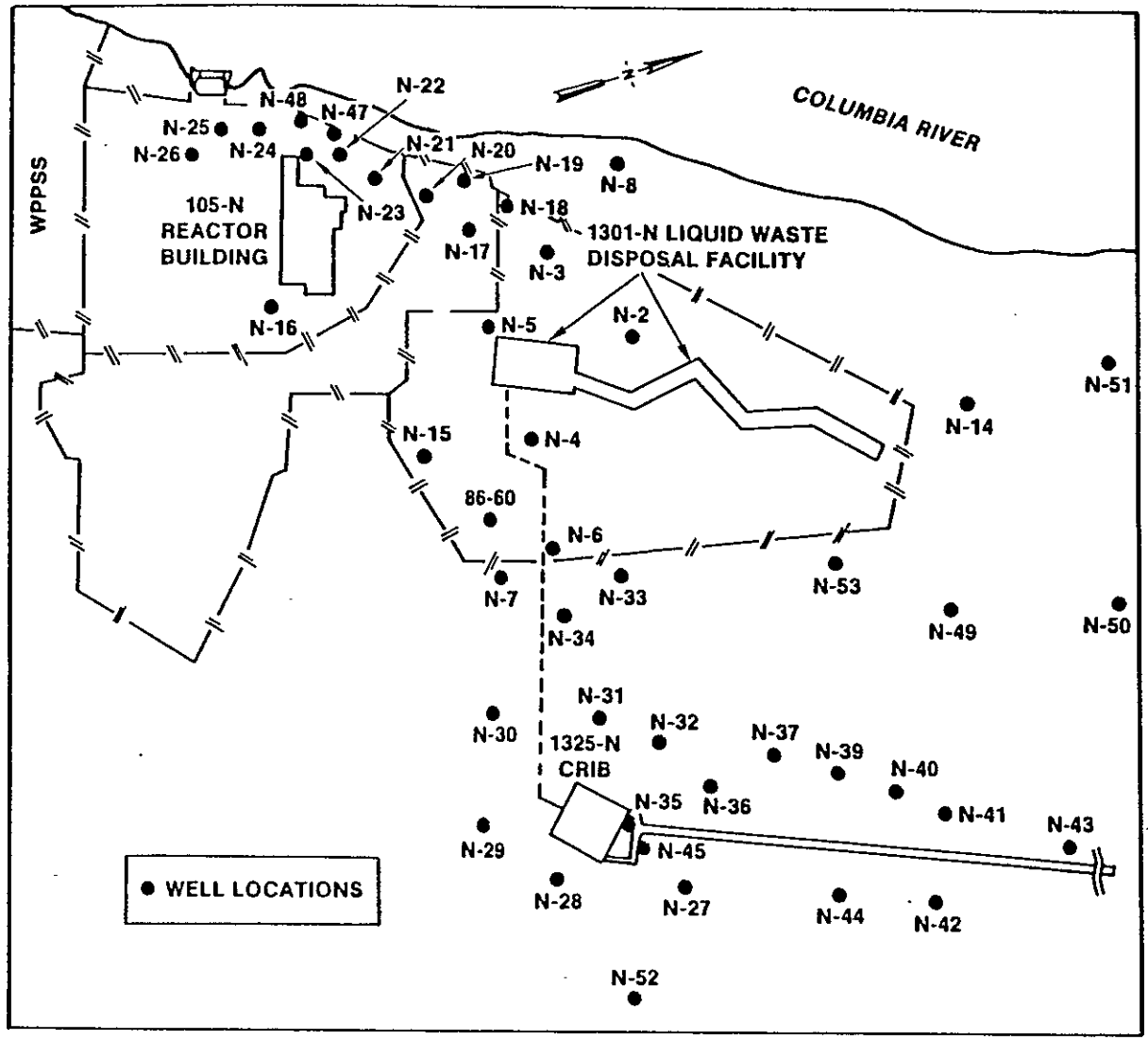

FIGURE 5-5
LOCATION OF GROUND-WATER WELLS AT 100-N AREA

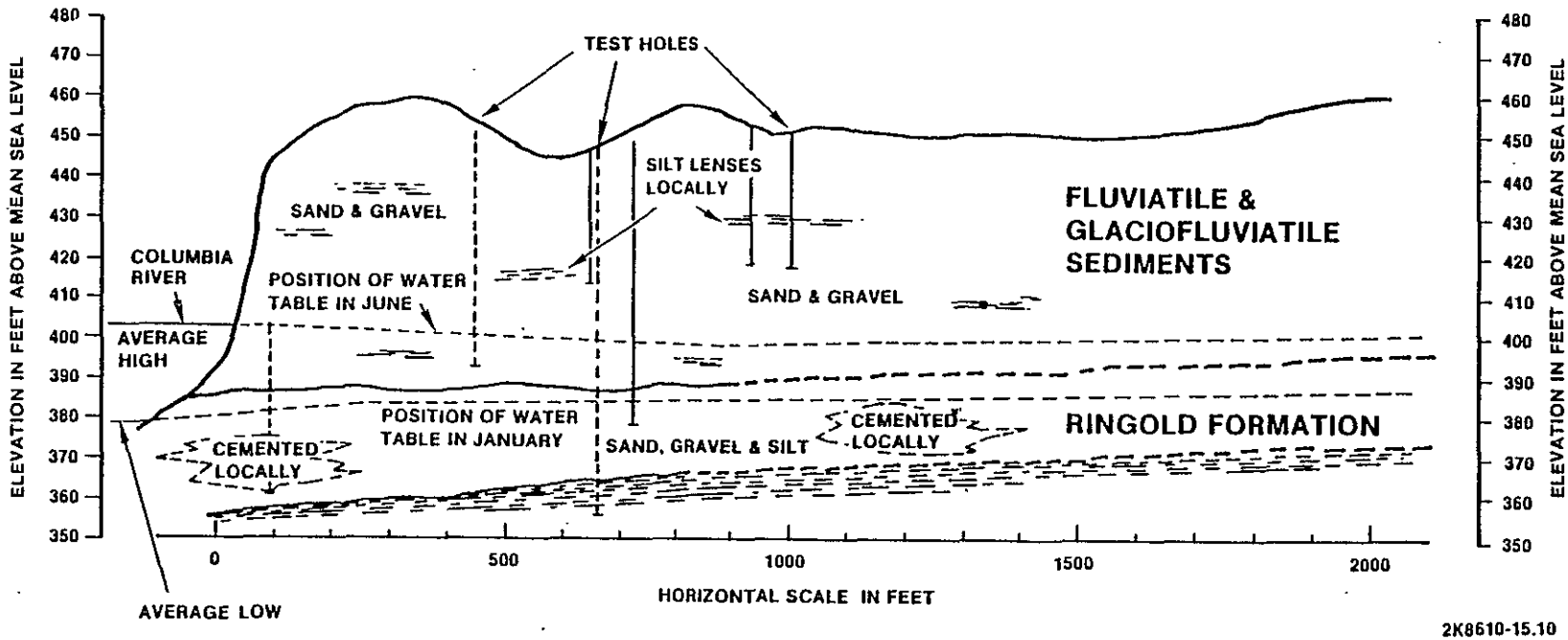

FIGURE 5-6
GEOLOGIC CROSS SECTION OF 100-N AREA

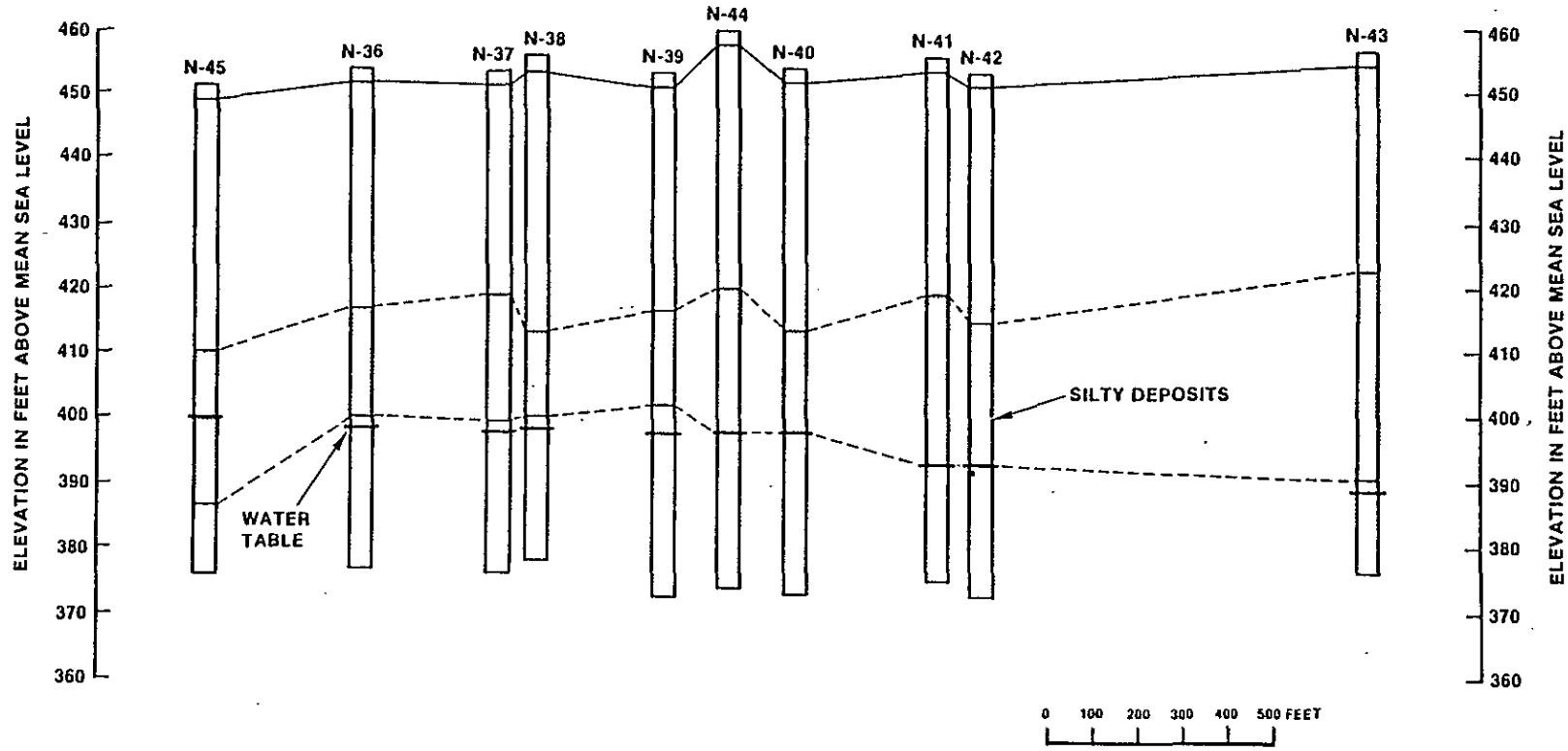

FIGURE 5-7
SILTY DEPOSITS IN 100-N AREA WELLS

composition of the drilling samples. Although its character changes somewhat in the lateral direction, this silty deposit is continuous in the study area covered by the new wells.

This silty deposit is located between the land surface and the present water table (Figure 5-7). The top of the deposit is about 36 to 44 feet below the land surface; corrected to mean sea level, the elevation of the deposit's top is about 414 to 420 feet. This deposit extends down to the present water table in most of the wells, and its thickness ranges from about 15 feet to over 30 feet.

Below the basin, the saturated ground water level is about 375 to 405 feet above mean sea level. This elevation is from 30 to 40 feet above the top of the Ringold clay unit. Figure 5-6 shows the water levels which were measured in 1986.

The water table map indicates that ground water movement is toward the river in the study area (Figure 5-8). Travel times from the crib to the river have been calculated to be within 4 to 17 days, based upon past flow path analysis.

Figure 5-9 is a generalized geologic column for the 100-N Area.

5.3d Regional Hydrologic Setting

5.3d(1) Surface Hydrology of the Hanford Site and Surrounding Pasco Basin

In the Pasco Basin, the Columbia River receives surface drainage from several adjacent basins. These major tributaries include the Yakima, Snake, and Walla Walla Rivers. No perennial streams are supported by hydrologic systems operating solely within the Pasco Basin. Streamflow within the Pasco Basin is recorded as inflow at the U.S. Geological Survey gauge below Priest Rapids Dam and outflow at the gauge below McNary Dam. Average annual flow at these stations is 87×10^6 and 140×10^6 acre-feet per year, (10×10^{12} and 17×10^{12} cubic meters per year) respectively. A total gauged flow of

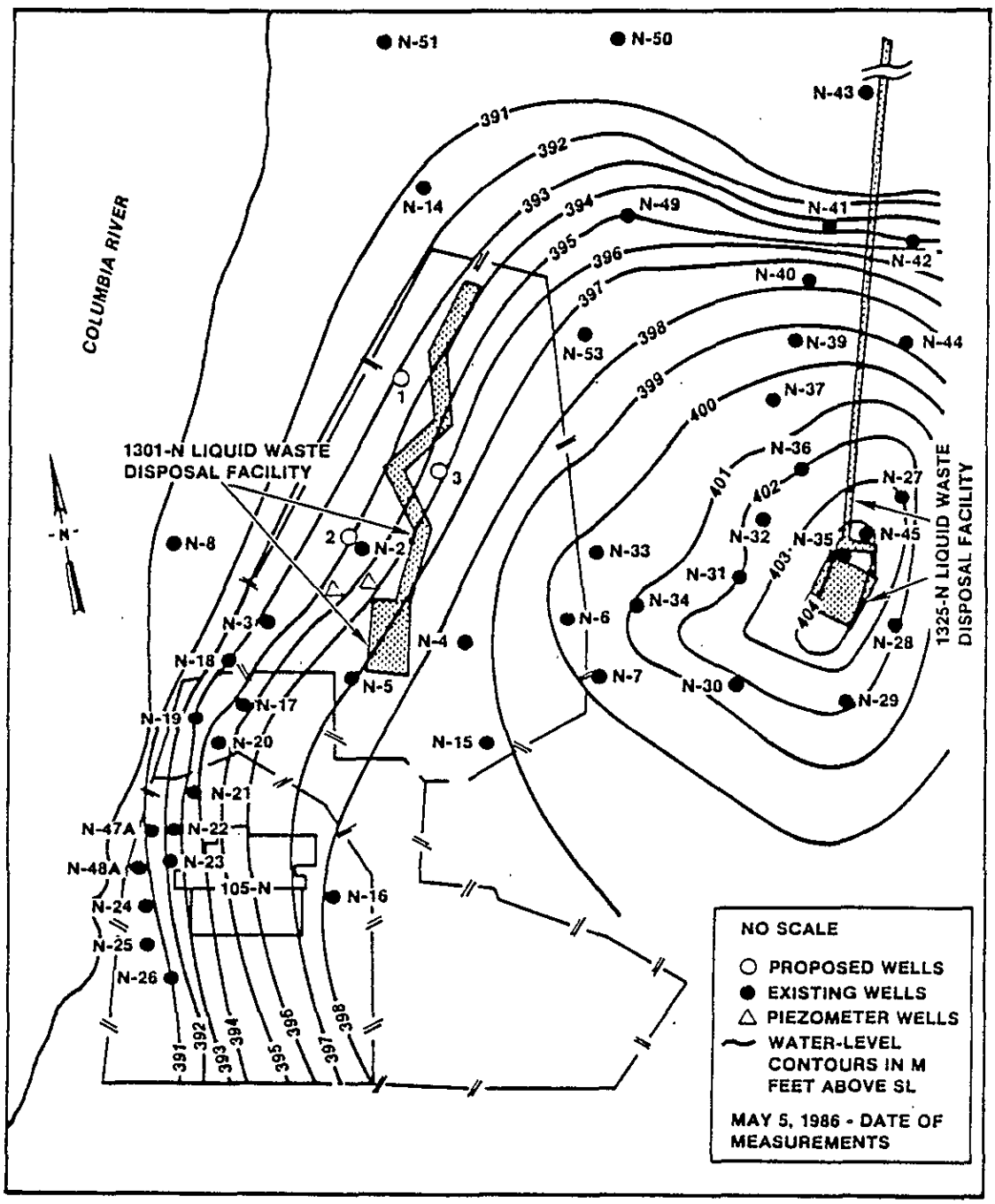

FIGURE 5-8
100-N AREA WATER-TABLE CONTOUR MAP

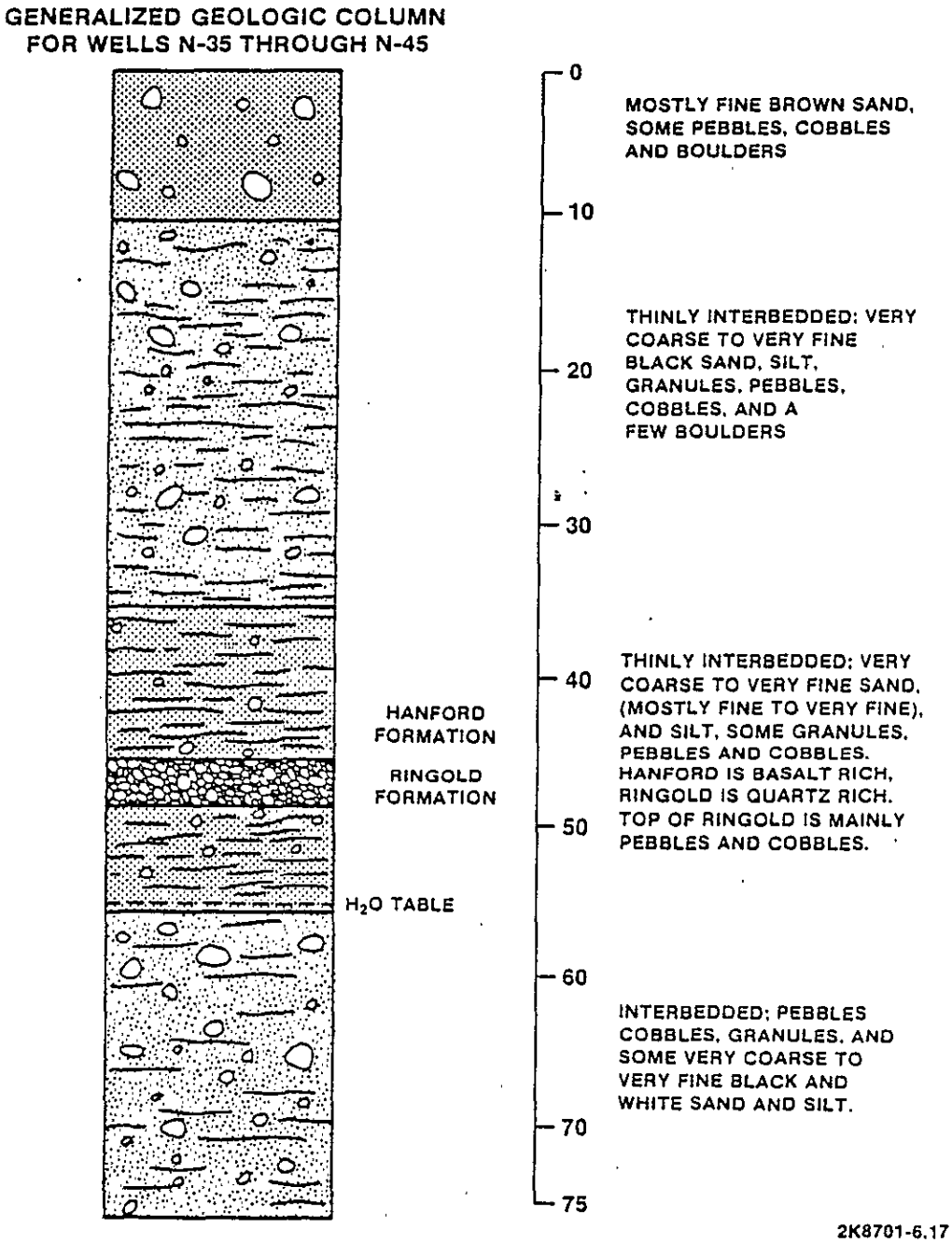

FIGURE 5-9
GENERALIZED GEOLOGIC COLUMN OF THE 100-N AREA

approximately 45 X 10^6 acre-feet per year (5.5 X 10^{10} cubic meters per year) enters from tributaries, and an additional 2.3 X 10^5 acre-feet per year (2.8 X 10^8 cubic meters per year) enter as irrigation returns.

The Hanford Site occupies approximately one-third of the land area within the Pasco Basin. Primary surface-water features associated with the Hanford Site include the Columbia and Yakima Rivers. Several artificial surface ponds and ditches are present, and are generally associated with fuel and waste processing activities (Figure 5-10).

The section of the Columbia River along the Hanford Site reach has been inventoried and was described in detail by the U.S. Army Corps of Engineers (COE, 1977). Flow along this reach is controlled by the Priest Rapids Dam. Several drains and intakes are also present along this reach. Most notably, these include irrigation outfalls from the Columbia Basin Irrigation Project and Hanford Site intakes for the on-site water export system. Intake and outfall structures for the Hanford Generating Project and N-Reactor also occur in the Hanford Reach.

West Lake, a shallow pond 3 feet (1 meter) deep, is the only natural pond on the Hanford Site. The pond generally averages 10 acres (0.04 square kilometers) in size. A number of man-made ditches and ponds are used for the routine disposal of chemical processing cooling waters, plant cooling water and several laboratory waste water streams (ERDA, 1975).

The Cold Creek watershed (area draining into Cold Creek) is located along the western boundary of the Pasco Basin. The 200 East Area lies outside the Cold Creek watershed. Cold Creek, trending northwest-southeast within the wash, is the only defined channel within the southeastern portion of the Hanford Site watershed (Figure 5-10). The drainage system within the Cold Creek watershed may be described as ephemeral and discontinuous.

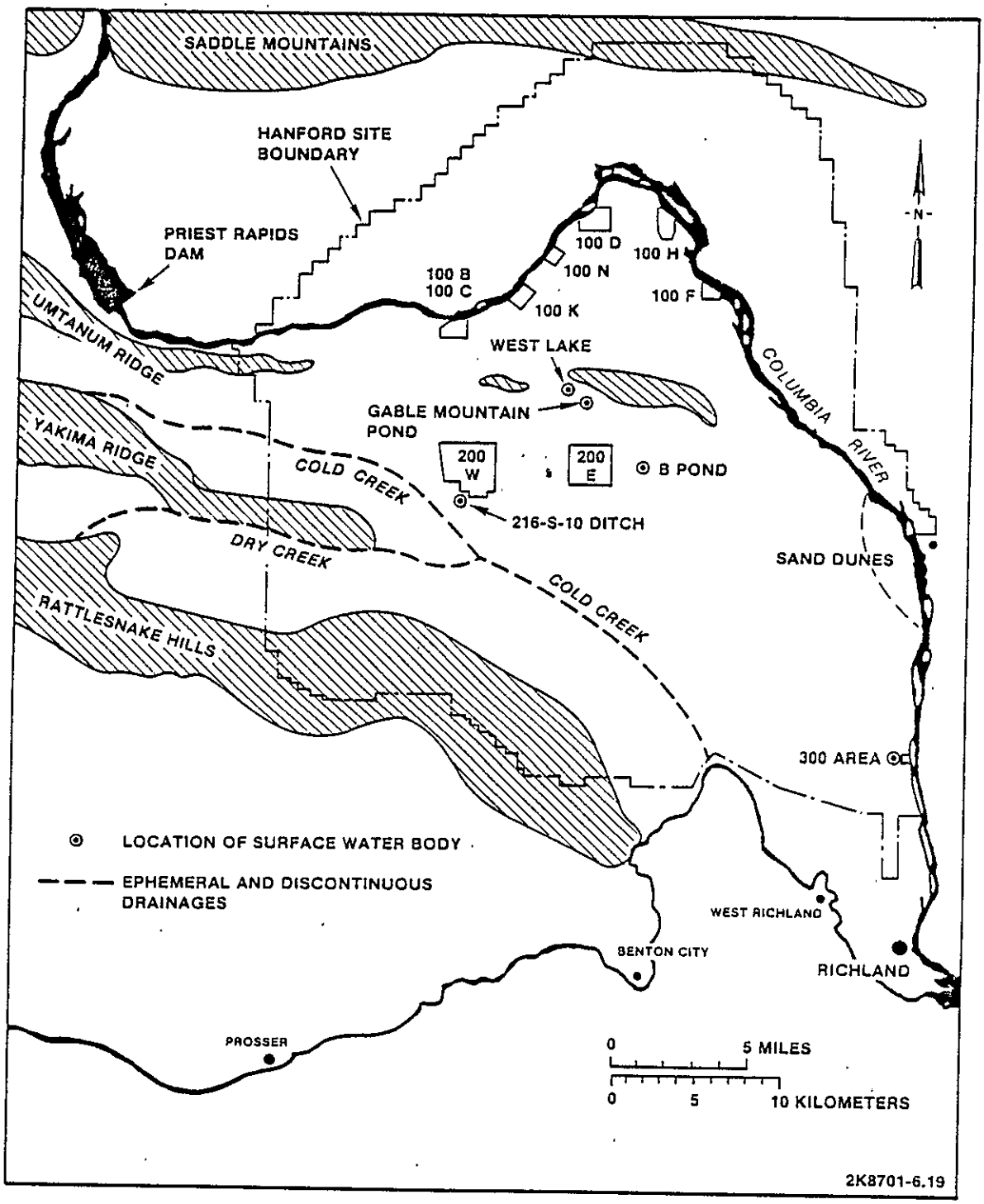

FIGURE 5-10
SURFACE WATER BODIES INCLUDING EPHEMERAL STREAMS
ON THE HANFORD SITE

5.3d(2) Aquifer Identification

5.3d(2)(a) Background

The subsurface of the Hanford Reservation is underlain by various geologic units having widely different water-bearing properties. The rock types include: unconsolidated silts, sands and gravels; semiconsolidated lake and stream sediments; and dense basalts with interbeds separating individual flows. From a hydrologic standpoint the most permeable horizons are the sands and gravels of the Upper Ringold Formation and the Pasco Gravels. The water table over the western portion of the Hanford Reservation lies at the top of the Ringold Formation. However, between the high terrace plateaus and the Columbia River, the water table rises above the Upper Ringold and intersects the overlying Pasco Gravels.

Above the water table lies the unsaturated or vadose zone. Any waste that percolates into the subsurface within the 100 Areas of the Hanford Reservation must flow through a section of unsaturated glaciofluviatile sediment prior to reaching the water table.

The uppermost aquifer lies between the water table and the silts and clays of the Middle and Lower Ringold Formation. In general, ground water in these unconsolidated and semiconsolidated sediments occurs under unconfined or water table conditions, although locally confined zones exist. Some semiconsolidated gravels and sands are locally found in the Lower Ringold Formation. These beds are usually separated from the overlying unconfined aquifer by a layer of silt and clay of variable thickness. These sands constitute the uppermost confined aquifer.

The Ringold Formation overlies a warped and severely deformed layer of basalt. The Columbia River basalt series has, in general, a saucer-shaped synclinal structure. It is an accordantly layered sequence of flows which were extruded as highly fluid lava in Miocene and early Pliocene time. Narrow zones of rubbly, permeable scoria somewhat similar to flow breccia occur at the top of a few flows and may be quite permeable. Some of these permeable zones in the basalt may constitute rather good confined aquifer systems.

During the past 30 years, wells have been drilled at Hanford through all the above-mentioned formations in order to:

- o provide water,
- o provide quantitative data for evaluating the chemical and physical properties of the underlying material,
- o measure the hydrological characteristics of the various sediments,
- o determine engineering design,
- o monitor waste disposal facilities, and
- o monitor the radiological status of the ground water.

The Hanford Site Water Table map in Appendix A shows the location of some of the wells available for hydrological measurements.

The aquifers in the Hanford Reservation have been studied extensively using data from existing wells, predictive mathematical studies, and regional hydrologic studies. All these data have been used in preparing the subsequent sections.

5.3d(2)(b) The Unconfined Aquifer

The unconfined aquifer consists of both glaciofluviatile sand and gravel deposits and the Ringold silts and gravels. Since these materials are very heterogeneous, often greater lithologic differences appear within a given bed than between beds (Gephart et. al., 1979; Graham et. al., 1981). The aquifer bottom is the basalt bedrock in some areas and silt/clay zones of the Ringold Formation in other areas. The impermeable boundaries of the unconfined aquifer within the Hanford Reservation and vicinity are the Rattlesnake Hills, Yakima Ridge, and Umtanum Ridge to the west and southwest. Gable Mountain and Gable Butte, as well as other small areas of basalt outcrop above the water

table, also impede the ground water flow. The Yakima River forms a hydraulic potential boundary which is mainly a discharge boundary for the aquifer. However, the ground water flow from 1 to 3 miles inland from the Columbia River is affected by seasonal river stage fluctuations. The flow pattern that originally prevailed in the unconfined aquifer was primarily to the east and northeast with discharge into the Columbia River. Natural recharge occurs at the foot of Rattlesnake Hills and Yakima Ridge. Surface flow sinks into the floor of the valley at the foot of the paralleling Rattlesnake Hills. The underflow is to a great extent interrupted by a buried extension of Yakima Ridge which parallels Rattlesnake Hills at a distance of about 2 miles and which rises above the water table.

The regional water table is largely within the Ringold Formation and to a lesser extent in the Pasco Gravels. Geologic work has pointed to the existence of highly permeable sediment on portions of both the northern and southern flanks of Gable Mountain. A filled erosional channel southeastward from the western side of Gable Mountain toward the Columbia River permeable zones parallel the river.

In 1944, before operations at Hanford began, the hydraulic gradient in all but the south-westernmost portion of the Hanford Reservation was about 5 feet/mile (Figure 5-11). Waste disposal at Hanford raised the water table in the recharge sites and altered the existing hydraulic gradient (Figure 5-12). Local ground water mounds formerly existed at each reactor site along the Columbia River. The mound at the still active 100-N Area is the only one of these remaining. A minor recharge mound exists under the 300 Area. The differential change in the Hanford Site water table between January 1944 and January 1975 is demonstrated in Figure 5-13 (ARCO, 1975). A Hanford Site water table map is shown in Appendix A.

The natural recharge due to precipitation over the lowlands of the Hanford Reservation is not measurable since the evaporation potential during the summer months greatly exceeds total precipitation. Data on migration of moisture from natural precipitation in deep soils (below 30 feet) show movement rates less than 1/2 in./yr at one measurement site.

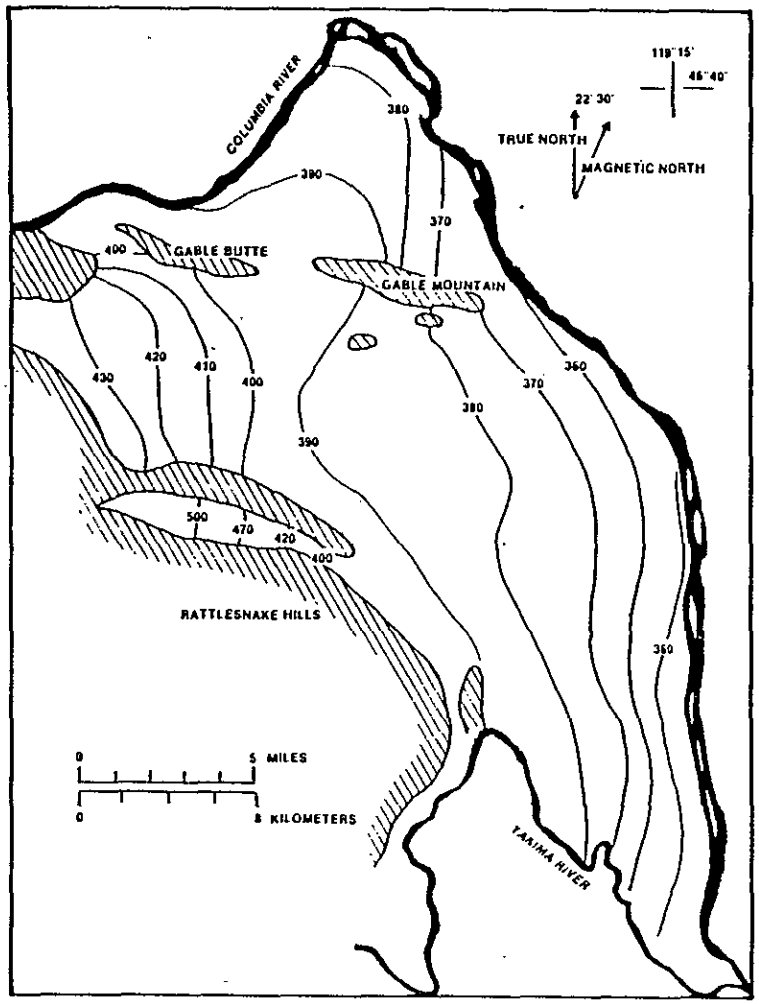

FIGURE 5-11
HANFORD SITE WATER-TABLE MAP, 1944

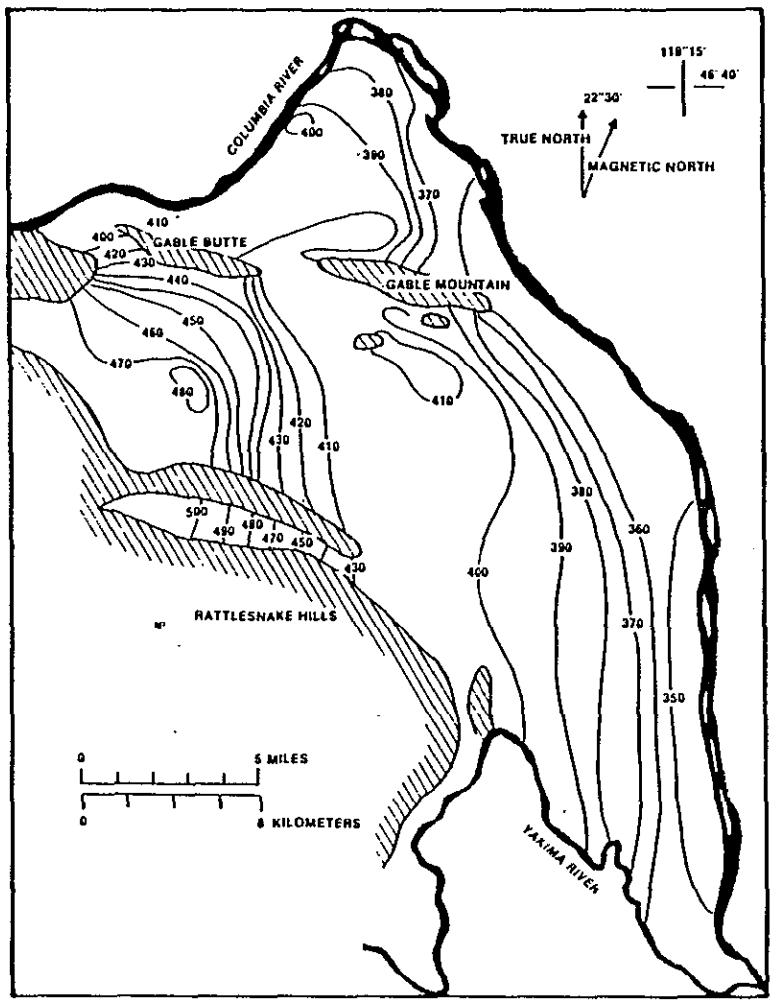

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FIGURE 5-12
HANFORD SITE WATER-TABLE MAP, 1978

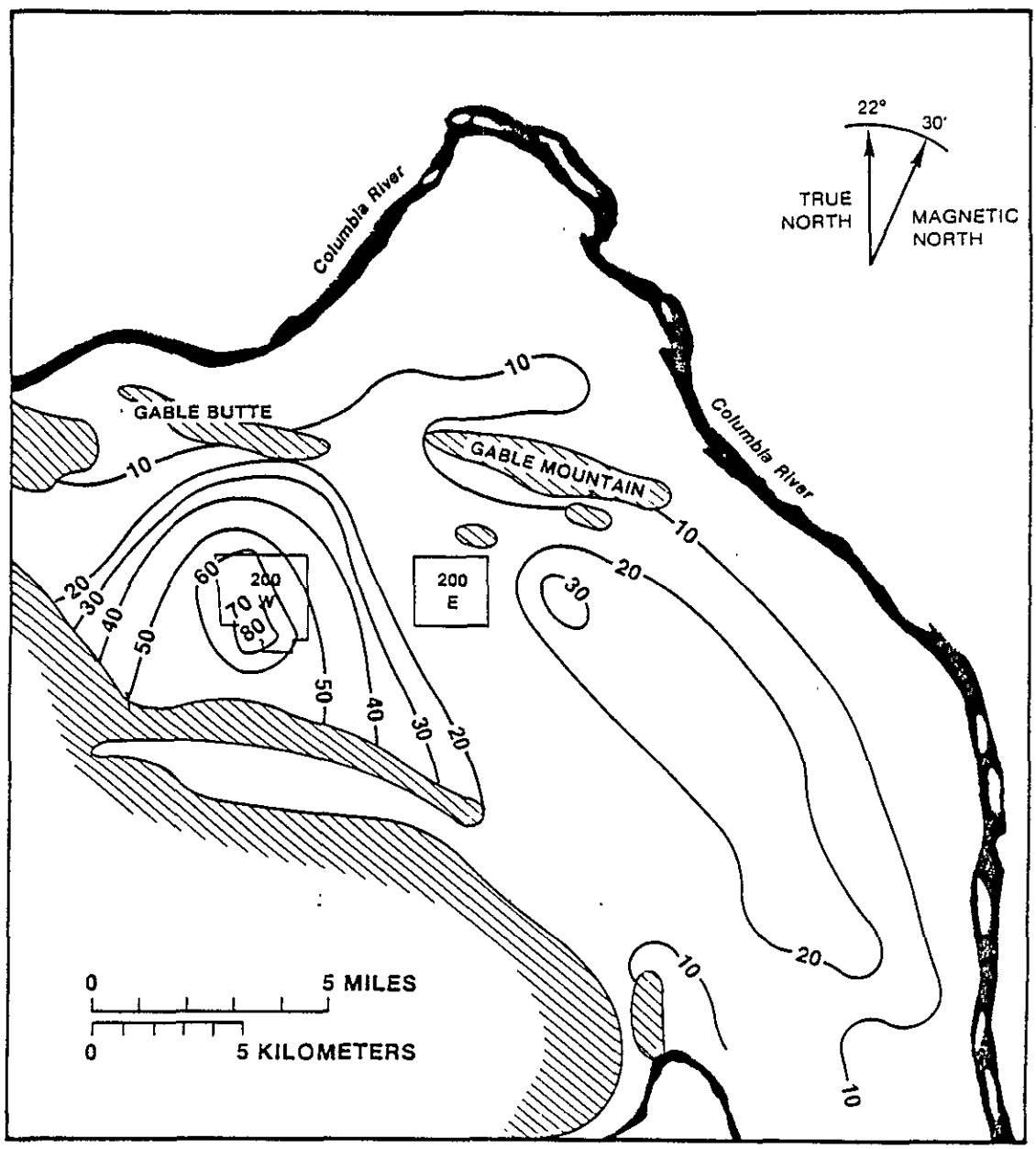


FIGURE 5-13
DIFFERENTIAL CHANGE IN THE HANFORD SITE WATER TABLE
BETWEEN JANUARY 1944 AND JANUARY 1975

To hydrologically describe an aquifer, four parameters should be considered. These are:

- o hydraulic conductivity: a quantity having the units of velocity that relate the flux of ground water to the hydraulic gradient
- o aquifer thickness: the thickness of permeable sediment lying between the water table or an upper confining bed and lower confining bed
- o effective porosity: the fraction of porous media capable of transmitting water
- o storage coefficient: the volume of water that a unit decline in head releases from storage in a vertical column of aquifer of unit cross-sectional area.

For an unconfined aquifer, the storage coefficient approaches the effective porosity. Therefore, to describe the unconfined acquifer underlying the Hanford Reservation, measurement is needed of the hydraulic conductivity, aquifer thickness and storage coefficient.

Qualitatively, the hydraulic conductivity and storage coefficient distributions are a function of the different geologic formations in the unconfined aquifer. Ancestral Columbia River channels incised in the Ringold Formation are filled with more permeable glaciofluviatile sediments. Channels of permeable sediments have been identified and are reflected in the ground water flow pattern of the region.

Quantitative measurements of the hydraulic conductivity have been made at several locations over the Hanford Reservation using a variety of techniques (Figure 5-14). Excluding clay zones, the values obtained for the Ringold Formation range from 10 to 7000 ft/day. Hydraulic conductivities of glaciofluviatile sediments range from 500 to 20,300 ft/day (Gephart et. al, 1979) (Table 5-1). The hydraulic conductivity distribution has been obtained using pumping test data and information from driller logs.

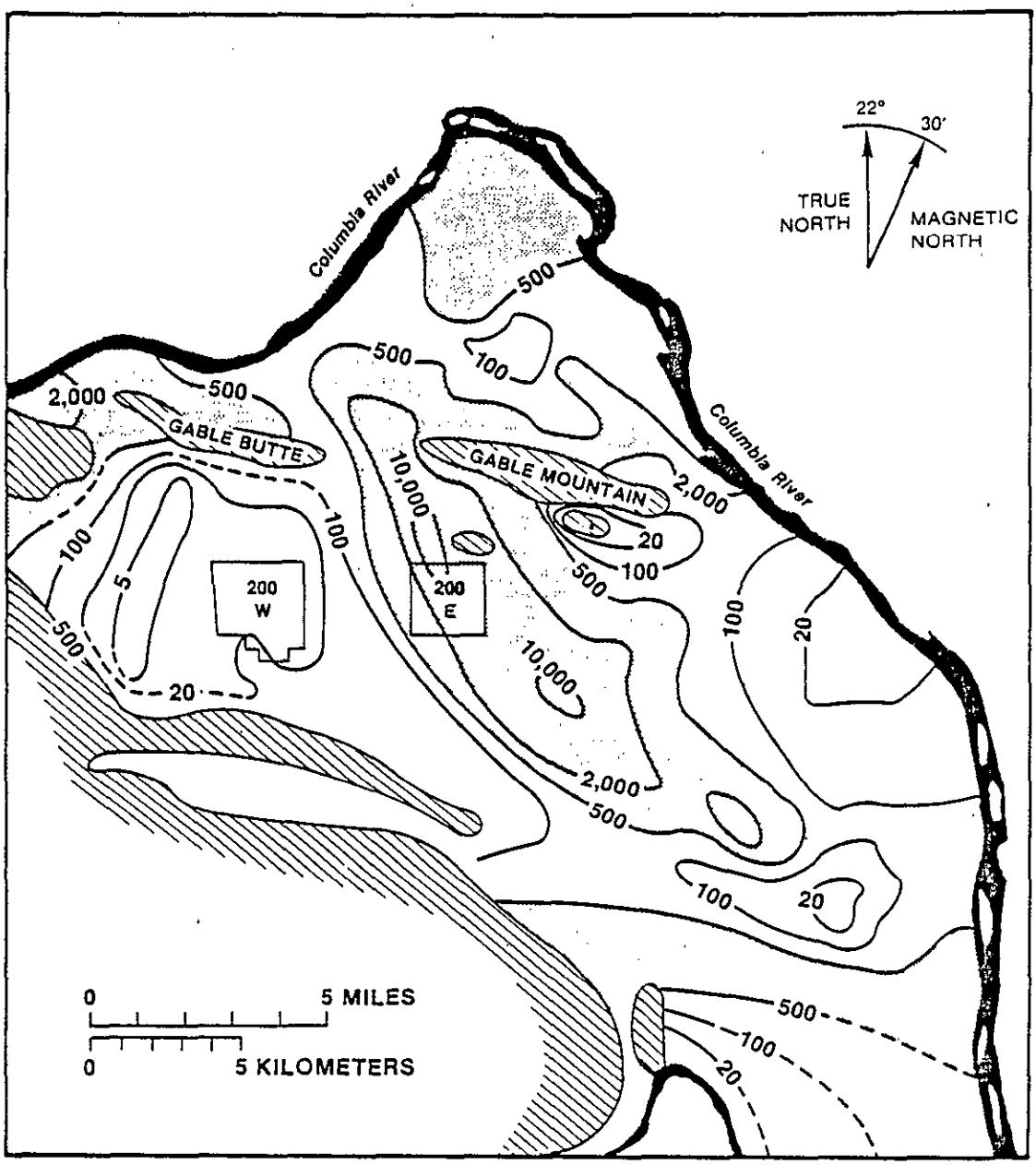


FIGURE 5-14
AREAL DISTRIBUTION OF HYDRAULIC CONDUCTIVITY FROM THE UPPERMOST AQUIFER AT THE HANFORD SITE

TABLE 5-1

REPRESENTATIVE HYDRAULIC PROPERTIES IN THE UPPERMOST AQUIFER*

Stratigraphic Interval	Hydraulic Conductivity (ft/day)	Conductivity (m/day)
Hanford Formation (informal name)	500-20,300	150-6,100
Undifferentiated Hanford and Middle Ringold Unit	100-7,000	30-2,100
Middle Ringold Unit	20-600	6-180
Lower Ringold Unit	0.1-10.0	0.03-3.0

*Modified after Gephart, et. al., 1979

Storage coefficient values were measured in the field by using pumping tests. For unconsolidated sediments, the storage coefficient ranges between 0.05 and 0.3. However, few measurements of the storage coefficient have been made to-date at Hanford. The bottom of the unconfined aquifer has been determined throughout the Reservation using data from wells. The surface depicting the aquifer bottom corresponds to basalt bedrock in some areas and silt-clay zones of the lower Ringold Formation in other areas. Ultimately, all ground water in the unconfined aquifer flows into the Columbia River except for that small amount which is lost to the atmosphere by evapotranspiration.

The chemical quality of the ground water in the unconfined aquifer is measured semiannually at seven locations. Sodium, calcium, and sulfate ions are measured as well as pH. Water from wells in the 300 Area is analyzed for chromium and fluoride ions associated with fuel manufacturing operations. Nitrate ion, which is a waste product from the manufacturing and chemical separations operations, is monitored over the entire Hanford Reservation. Maps of the nitrate ion concentration near the water table of the unconfined aquifer are published semiannually.

The temperature of the ground water in the unconfined aquifer has been measured on an intermittent basis. Local thermal anomalies may be caused by vertical flow within a well casing. In the past, 100 Area reactor ground water mounds contained water on the order of 70-90°C.

5.3d(2)(c) The Confined Aquifers

A confined aquifer is one where the water-bearing stratum is overlain and underlain by relatively impermeable beds. Confined aquifers in the Hanford Reservation include 1) permeable sands and gravels in the lower part of the Ringold Formation overlain by thick silts and clays and 2) extensive basalt interbeds confined by individual basalt flows. The confining beds include sequences of individual basalt flows, where they are continuous and greater than about 50 feet thick, and the silts and clays of the lower part of the Ringold Formation. Within the basalt sequence, ground water is transmitted primarily in the interflow zones, either in sedimentary beds or in the scoria

and breccia zones forming the tops and bottoms of the flows. Some of the basalt flows in the Pasco Basin have been eroded, particularly in the anticlinal ridges. In some locations, the basalts are highly jointed and contain breccia, pillow and palagonite complexes through which ground water can move. The lower-most Ringold Formation silts and clays are of various thicknesses, and distinct hydraulic potential differences have been observed below the silts and clays. About 90 wells on the Hanford Reservation have been drilled to basalt. Most of these wells only barely penetrate the top basalt flows. Thus, data on the confined aquifers in the basalt flows are scarce and much more data must be gathered to fully characterize these aquifers. In general, the hydraulic potential observed in the confined aquifer zones above the basalt is greater than in the overlying unconfined aquifer. However, the flow rates are expected to be quite small due to the low transmissivity range of this water-bearing zone.

In 1970 and 1971, 23 wells penetrating the sands in the lower Ringold Formation and the first few basalt flows and interbeds were pump tested and transmissivity values calculated. From these tests, values of transmissivity ranging between 2 and 8 ft^2/day were obtained for the confining beds and values between 50 and 2,000 ft^2/day for the permeable horizons. The hydraulic conductivity of the confining beds ranges between 0.02 and 0.2 ft/day and that of the aquifer, ranges between 2 and 30 ft/day.

Some data on the aquifer properties of the various confined aquifers are available from the ARHCO deep drilling project well ARH-DC-1 (Figure 5-15). At this well the basalt from 362 to 1200 feet depth has a transmissivity of 695 ft^2/day. A sedimentary unit contained in this zone from 830 to 936 feet has a transmissivity of 355 ft^2/day. A dense basalt zone from 960 to 1090 feet depth has a transmissivity of 0.2 ft^2/day. There is one significant water-bearing zone, 10 feet thick, occurring at 3230 feet depth with a transmissivity of 68 ft^2/day.

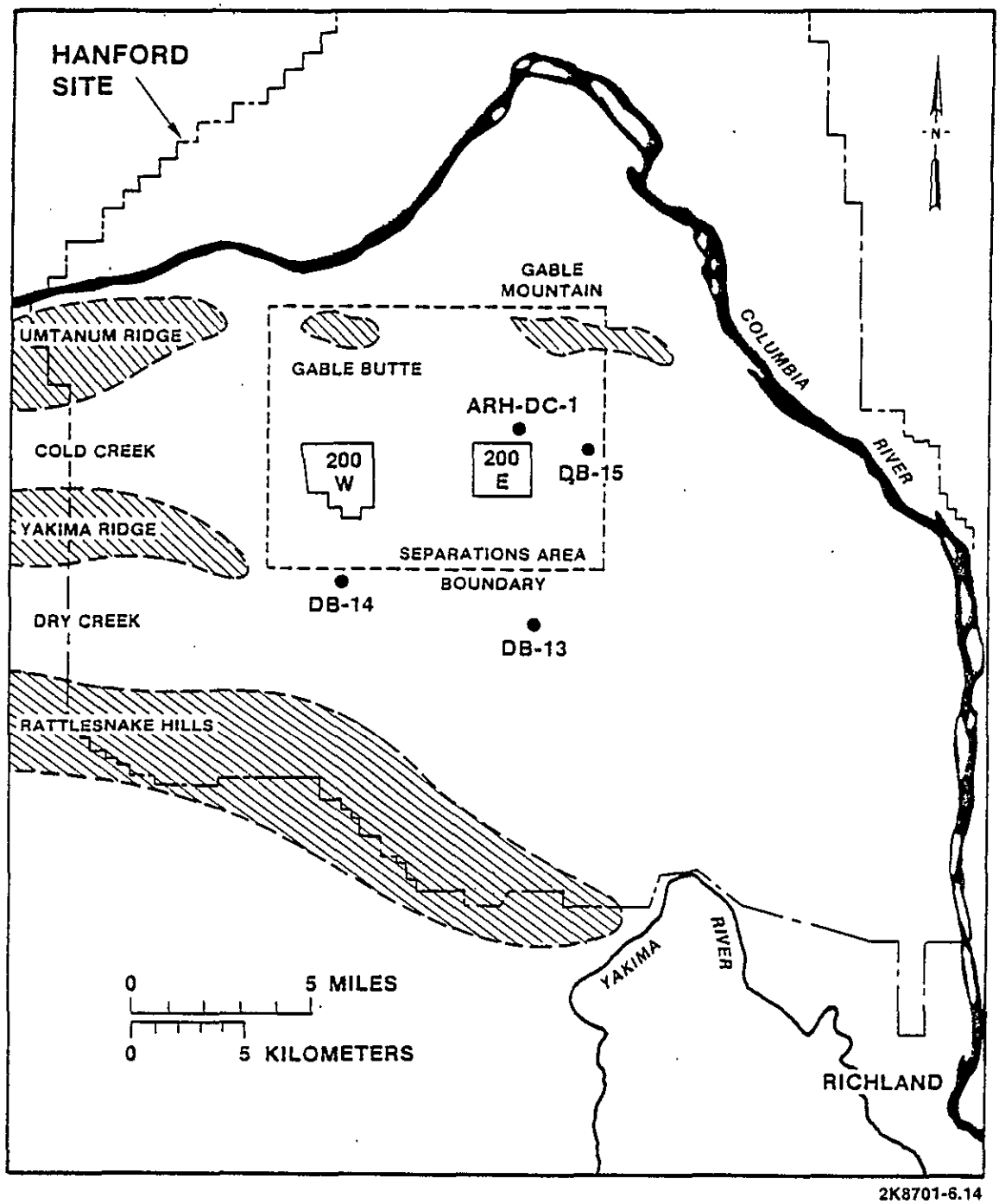


FIGURE 5-15
LOCATION OF WELLS DB-13, DB-14, DB-15, AND ARH-DC-1

Water-bearing sedimentary interbeds are centered at 500, 650, and 900 feet and range from 25 to 100 feet thick. The bed at 900 feet is about 100 feet thick consisting of well-sorted medium sand of moderate permeability. Its hydraulic conductivity is about 3.5 ft/day, making it the most productive aquifer penetrated by this well.

Data on the storage coefficients on the basalt aquifers are very inconclusive. All evidence so far suggests that the storage coefficient in these aquifers is approximately equal to the compressibility of water. This suggests that these aquifers behave as elastic bodies.

5.3d(3) Aquifers North and East of the Columbia River

Very little data are available on the ground water aquifers to the north and northeast of the Columbia River. The confined basalt aquifers underlie this area as well as the present Hanford Reservation. The unconfined aquifer exists only under the parts of the Wahluke Slope between the higher bluffs and the Columbia River. The Ringold Formation and glaciofluviatile sediments form this aquifer.

The Saddle Mountains form the northern boundary to the confined aquifers and are a potential recharge site from precipitation due to basalt flow outcropping. The Columbia River behind Priest Rapids Dam and Wanapum Dam and the Columbia Basin Irrigation Project are other probable recharge areas. The Columbia River forms the primary discharge boundary for the unconfined aquifer. Seasonal river-bank storage and discharge occur as on the Hanford side of the river.

The remaining sources of recharge to the unconfined aquifer are the irrigation wasteways and ponds that have been created. There are no observation wells monitored by DOE to record the recharge effects of these ponds. The water table elevations in the unconfined aquifer near the Columbia River range from 370 to 405 feet MSL at the four available observation wells. The hydraulic potentials in the wells that penetrate the confined aquifers average about 50 feet higher. These wells are also perforated in several basalt aquifers precluding representative potential measurements.

5.3e Hydrology of the 100-N Area

In the region of the 100-N Area during the low stage of the river-flow the elevation of the water table is at its minimum level. In this position the ground water body is entirely within the sand, silts, and gravels of the Ringold formation. These materials for the most part are unconsolidated; in certain areas, however, they have been cemented by calcium carbonate and iron oxides. The average permeability of these rocks ranges from 100 gpd/ft^2 to 600 gpd/ft^2 on unit gradient, depending largely on the amount of fines and the degree to which the material had become cemented. It is conceivable that the permeability of the material comprising this zone could differ by one or two orders of magnitude from one location to another.

In the late spring and early summer flood waters moving down the Columbia River cause the water table to rise. During the rising stage the water table moves upward into more permeable fluviatile and glaciofluviatile rocks. The rock fragments associated with these deposits are generally coarse sands and gravels with only small amounts of silt and clay.

The methods used to calculate aquifer characteristics generally give average values over the whole aquifer thickness. The aquifer thickness and the type of material through which the ground water is percolating establish the measured characteristics. It would be expected that the values measured during the winter months would be significantly different from those measured in the summer.

Figure 5-14 is a geologic cross section constructed through the 100-N Area normal to the Columbia River. In this figure, two relative positions of the water table are shown. The lower of the two is based on an average minimum flow rate of the Columbia River and the other is based on an average maximum flow rate. The rocks through which the ground water percolates at these two extreme stages are also indicated. The sands and gravels of the Ringold formation are shown to be locally cemented although the degree of cementation and the areal extent of the cemented zones are not known. The total aquifer thickness may be as much as 80 or 90 feet.

It was recognized that the aquifer characteristics change significantly from one season to the next as a result of water table fluctuations. Therefore, the measurements of the water table and river-level elevations to determine the transmissibility were made during the high water stage to include contributions of all geologic units that might comprise the aquifer. The transmissibility obtained from these measurements is representative of the unconfined aquifer underlying the 100-N Area, involved in most waste disposal problems.

Based on the transmissibility data and the coefficient of storage of the aquifer and using an average aquifer thickness of 20 feet, the average permeability of the aquifer ranges from 1,500 gpd/ft^2 to 3,000 gpd/ft^2.

The seepage velocity, based on the calculated average permeability and the maximum gradient observed during the period studied was determined to be three to four feet/day. The natural ground water would not attain this velocity. Sometimes the river level rises so rapidly that the normal gradient toward the river is reversed. This reverse gradient away from the river has been detected several thousand feet inland at certain locations on the project. Beneath the 100-N Area the reversed gradient might extend as much as 1000 feet from the river.

5.4 CONTAMINANT PLUME DESCRIPTION

Extensive ground water monitoring for radionuclides has been conducted near the 1301-N Liquid Waste Disposal Facility. There is very little ground water information about hazardous or dangerous wastes that were discharged into the facility.

As indicated in Section 3.1, samples taken at the point of discharge into the 1301-N Liquid Waste Disposal Facility did not contain any nonradioactive dangerous wastes or dangerous waste constituents (listed in WAC 173-303-9905). Therefore, nonradioactive hazardous waste is not expected to be present in the ground water at the 1301-N Liquid Waste Disposal Facility.

The location of the existing ground water monitoring wells near the 1301-N facility are shown in Figure 5-5. These wells are all completed at various depths within the unconfined aquifer and are similar in design. Wells N-2 through N-26 have varing lengths of perforated steel casing. Wells N-27 through N-53 have a 20 foot stainless steel screen at the water table. The general construction of the perforated steel casing wells (those wells closest to the 1301-N Liquid Waste Disposal Facility) are diagramed in Figure 5-16. Each well that is used for monitoring radionuclides in the ground water has a dedicated submersible pump.

Should the proposed ground water monitoring program, described in Section 5.5 indicate hazardous or dangerous waste contamination of the ground water at the facility, studies will be undertaken to characterize the plume of hazardous or dangerous waste contamination at that time. This characterization would consider the extent of the plume and the concentration of each constituent throughout the plume.

5.5 GROUNDWATER MONITORING PROGRAM

5.5a Purpose

The purpose of this plan is to implement a hazardous waste ground water monitoring program at the 1301-N Liquid Waste Disposal Facility in accordance with the Resource Conservation and Recovery Act (RCRA) as described in 40 CFR 265.91. The scope for the plan includes the characterization of the hydrogeology and the monitoring of ground water beneath the 1301-N Liquid Waste Disposal Facility.

5.5b Objectives

The following objectives must be met to bring the 1301-N facility into compliance with the pertinent ground water regulations:

- Determine whether hazardous wastes reached the unconfined aquifer from the facility and still persist in the ground water.

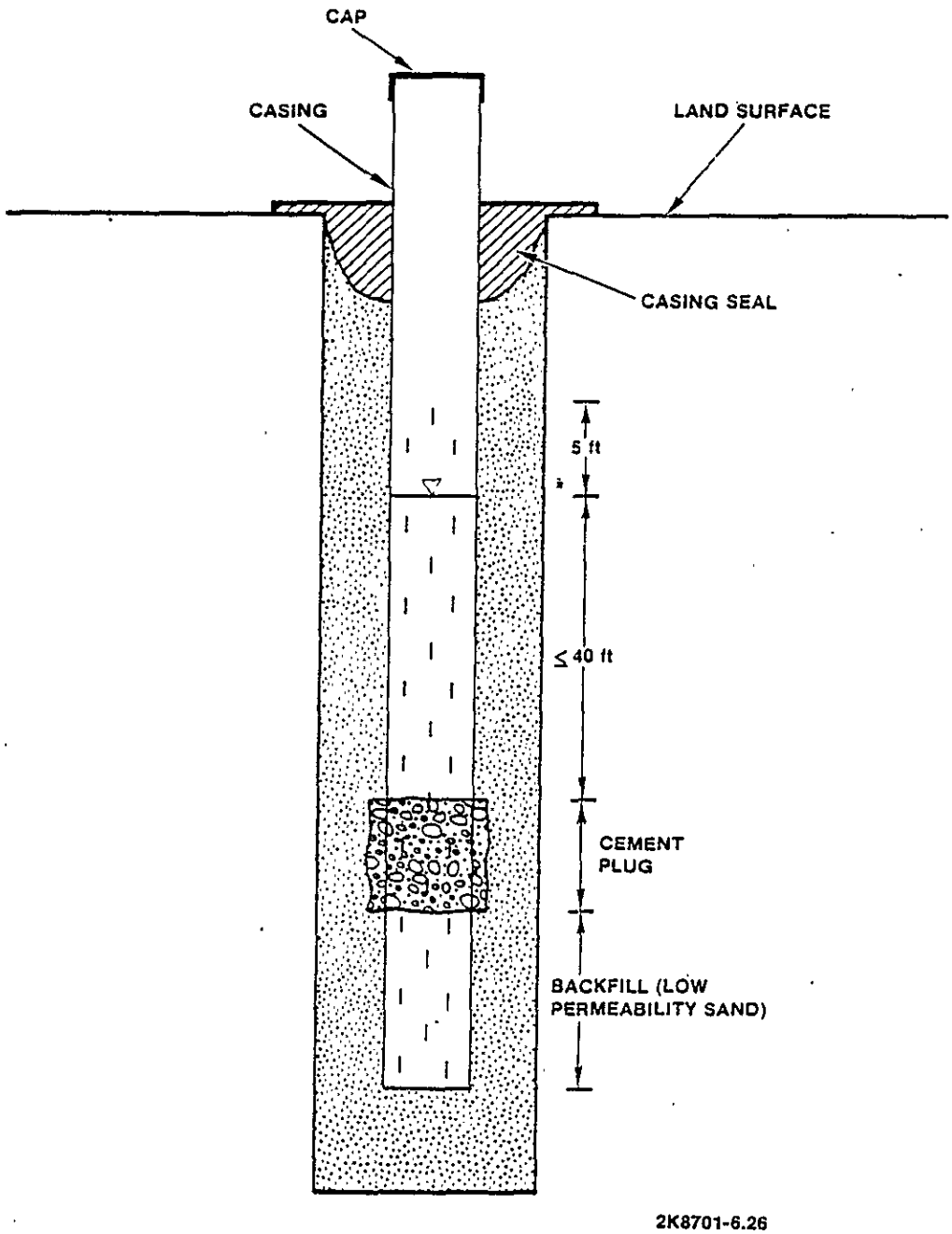


FIGURE 5-16
GENERAL CONSTRUCTION OF MONITORING WELLS N-2 THROUGH N-26

- o Refine the understanding and knowledge of the hydrogeology of the unconfined aquifer using existing data.

- o Determine the direction and rate of ground water flow.

- o Develop a better understanding of the hydrogeology of the Hanford formation and the Ringold Formation in the area of the facility.

5.5c Technical Approach

A two-phase approach will be used to meet the above objectives. Phase 1 will include: A detailed review of existing data, determination of which existing wells will be sampled, determination of new well locations, the drilling of wells, aquifer tests, and refinement of hydrologic and geologic data. Phase 2 will include: Collection of water-level data with time, design of a sampling system, determination of analyses to perform and assuring the adequacy of the new monitoring system. The details of the proposed approach to meet each of the objectives are discussed in detail in the following paragraphs.

5.5c(1) Phase 1

Phase one will consist of reviewing existing data, determining which existing wells will be sampled, determining where wells should be drilled, testing each well as it is drilled, and refining the hydrology and geologic data. Because the facility has an existing monitoring well network (Figure 5-5) and has received limited amounts of dangerous and hazardous wastes, the preliminary plan is to construct a minimum number of additional wells in order to meet the compliance requirements. Three new shallow wells are planned. The proposed locations of these new wells are indicated on Figure 5-8.

Six existing wells along with the three new wells will be sampled in the Phase I monitoring program. These existing wells are N-2, N-4, N-5, N-8, N-14, and N-53 (Figures 5-5 and 5-8).

The review of existing data will allow for a better understanding of where to start the drilling portion of the work. After the drilling has started, a careful analysis of the sediments derived from the drilling will be used to determine the potential for downward movement of hazardous contaminants. Specific data will be collected on mineralogy, grain-size analysis, temperature, conductivity, and water levels where saturated. After the well has been completed and screened at the appropriate depth, a flow meter will be installed to determine the direction and rate of ground water flow. These data will be used to refine the proposed location of the next well (Figure 5-8). As each well is completed, the flow meter data will be used to cross check the location of the remaining wells.

All planned wells will be installed using the cable tool or air rotary method. The wells will consist of an artificial sand-pack, stainless-steel well screen to above the water level and stainless-steel casing to land surface (Figure 5-17). The finished inside diameter of the wells will be 6 inches. Screened intervals will typically be 15 to 20 feet with the exact length depending on the thickness of the interval of interest. Drilling equipment, casings, and screens will be steam-cleaned prior to use and kept off of the ground.

Borehole geophysical logs will be made for each well upon reaching final depth and after completion. A qualified geologist will be present during drilling to examine the materials penetrated, prepare geologic logs, oversee the drilling activities, and revise well design if needed. Sediment samples will be collected every 5 feet and at changes in lithology.

After the completion of the wells, an aquifer test will be performed by pumping the most productive well to obtain the hydrologic characteristics. The remaining wells will be used as monitoring wells during the test. The selection of the pumping well discharge rate, and probable duration of the test will be determined by drawdown tests during well development and bailer tests performed on each well during drilling.

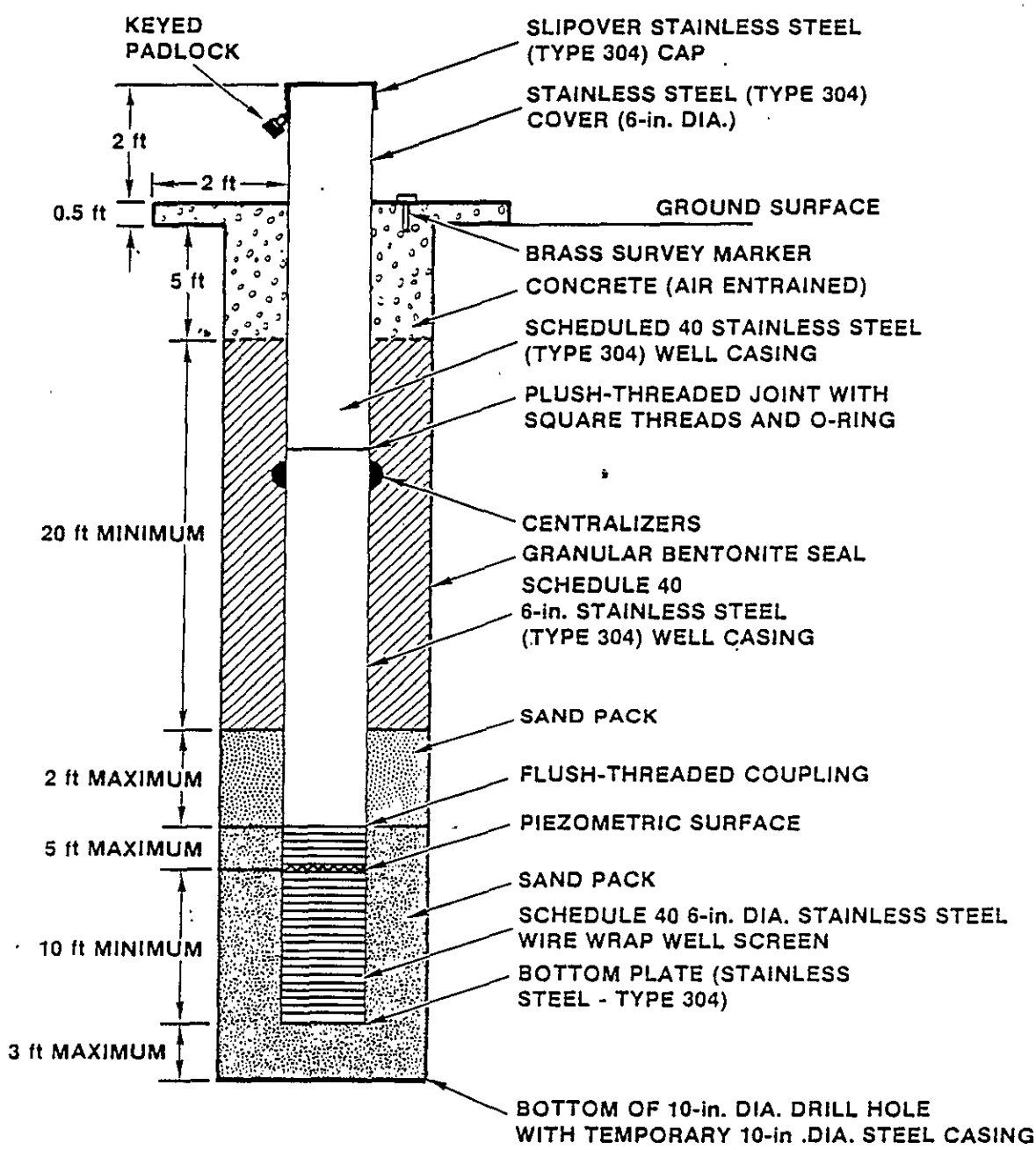


FIGURE 5-17
DIAGRAMMATIC SKETCH OF WELL STRUCTURE

Figure 5-8 shows the location of the proposed wells relative to the 1301-N Liquid Waste Disposal Facility.

5.5c(2) Phase 2

Phase two will include obtaining water level data with time, designing a sampling system, determining analyses to be performed on samples, and assuring the adequacy of the new ground water monitoring system for the 1301-N Liquid Waste Disposal Facility by the use of appropriate statistical methods, modeling, and data review.

In order for the collection of water level-data to be efficient, the measurements will be taken at the same time water samples are collected. The measurements will be taken with a calibrated steel tape and records kept in a field notebook.

To meet the requirements of a detection-level program, the analyses performed on ground water samples will include specific dangerous waste constituents known to be discharged to the facility, in addition to the mandated Drinking Water Parameters as specified in 40 CFR 265.92(b)(1), (2), and (3) (Tables 5-2, 5-3, and 5-4). Site specific parameters (based on Table 5-5) that will be analyzed include nickel, ammonium hydroxide, and hydrazine. Ground water quality parameters and ground water contamination indicators will also be included. Samples from selected wells will be analyzed for the parameters listed in WAC 173-303-9905 (Appendix E). Samples from selected wells (based on Phase I) will be collected and analyzed in addition to samples from the new wells on a monthly basis until a data base is established. After the data base is established, the schedule will be reevaluated and modified as appropriate.

Samples will be collected according to current established written procedures as described in PNL-MA-580 (PNL, 1986a). Water-level measurements will be taken before sampling, and the wells will be purged according to the borehole volume removal procedure. Samples will be collected using dedicated sampling pumps appropriate for the analyses to be conducted.

TABLE 5-2

MAXIMUM CONCENTRATION OF CONSTITUENTS FOR GROUND WATER PROTECTION IN 40 CFR 265.92(b)(1) APPENDIX III

CONSTITUENT	MAXIMUM CONCENTRATION Mg/l
Arsenic	0.05
Barium	1.0
Cadmium	0.01
Chromium	0.05
Fluoride	1.4-2.4
Lead	0.05
Mercury	0.002
Nitrate (as N)	10
Selenium	0.01
Silver	0.05
Endrin	0.0002
Lindane	0.004
Methoxychlor	0.1
Toxaphene	0.005
2,4-D	0.1
2,4,5-TP Silvex	0.01
Radium	5 pCi/
Gross Alpha	15 pCi/
Gross Beta	4 millirem/yr
Turbidity	1/TU
Coliform Bacteria	1/100 ml

TABLE 5-3

PARAMETERS ESTABLISHING GROUND WATER QUALITY
IN 40 CFR 265.92(b)(2)

Chloride
Iron
Manganese
Phenols
Sodium
Sulfate

TABLE 5-4

PARAMETERS USED AS INDICATORS OF GROUND WATER CONTAMINATION
IN 40 CFR 265.92(b)(3)

pH
Specific Conductance
Total Organic Carbon (TOC)
Total Organic Halogen (TOX)

TABLE 5-5

ESTIMATED AMOUNTS OF HAZARDOUS WASTE DISCHARGED IN A RADIOACTIVE WASTE STREAM TO 1301-N FACILITY

Compound	Amount (lb/yr)
Hydrazine Test Solution	6,100
Ammonia Test Solution	6,100
Chloride Test Solution	7,800
Fluoride Test Solution	3,900
Sodium dichromate	10,000 (up to mid- to late 1970s)
Lead-acetate battery fluid	630
Nickel-cadmium battery fluid	270
Hydrazine (injection system)	350

Samples will be sealed and transported to the laboratory using the established chain-of-custody procedures as outlined in PNL-MA-580.

QA/QC procedures will be the same as those described in the existing ground water monitoring plans for other Hanford facilities (PNL, 1986b).

Methods to be used for sample analysis, sample preservation, and data evaluation are the same as those in the existing RCRA ground water monitoring plans for other Hanford facilities (PNL, 1986c).

5.5d Anticipated Deliverables

Interim reports on the results of the characterization work will be produced at the end of Phase 1 and Phase 2. The final report will be compiled at the end of the project. In general, each report will contain: 1) narrative descriptions of the local geologic units and ground water flow; 2) geologic cross sections; 3) water-table maps; 4) geological and drilling logs; 5) results of the various tests conducted; and 6) analytical results.

5.5e Schedule

Drilling of the necessary characterization/monitoring wells is anticipated to commence after funding has been identified for well installation. Based on a drilling rate of 15 ft/day (8 hours) and an average depth of 90 feet, it is estimated that the drilling of each well will take about 6 working days with 3 working days for testing and screen installation, 3 working days to pull back the casing, and 1 day for recovery, for a total of 13 working days to complete each well.

5.6 DETECTION MONITORING PROGRAM

A ground water detection monitoring program will be developed. It is assumed that the ground water monitoring data will not indicate the presence of nonradioactive hazardous waste constituents in the ground water. This program will address:

- o indicator parameters to be sampled for,

- o a proposed ground water monitoring system,
- o background values for each proposed monitoring parameter,
- o ground water quality at point of compliance,
- o ground water flow rate and direction,
- o a description of proposed sampling, analysis and statistical procedures to be utilized in evaluating ground water monitoring data (PNL, 1986).

5.7 COMPLIANCE MONITORING PROGRAM

If the ground water monitoring data indicates the presence of dangerous constituents in the ground water at the point of compliance, a compliance monitoring plan will be developed and submitted to the Department of Ecology for approval. This plan will provide:

- o a description of the wastes previously handled at the facility,
- o a characterization of the contaminated ground water,
- o a list of constituents which will be monitored (may include part of the WAC 173-303-9905 List) (Appendix E),
- o proposed concentration limits for those constituents,
- o a description of the proposed ground water monitoring system,
- o a description of proposed sampling, analysis and statistical procedures to be utilized in evaluating ground water monitoring data (PNL, 1986), and
- o continual evaluation of the compliance monitoring program and corrective action.

5.8 CORRECTIVE ACTION PROGRAM

The interim status program is designed to provide a description of the appropriate corrective actions, but the presently available monitoring data are not sufficient. Therefore, plans for a corrective action program will be determined after enough data are collected.

5.9 REFERENCES

Appendix D.

6.0 CLOSURE AND POST-CLOSURE PLAN

The 1301-N Liquid Waste Disposal Facility is a land disposal facility that received radioactive liquid wastes containing a limited amount of hazardous chemical constituents from 1963 until September 1985 (for the composition of the discharge to the 1301-N facility see Section 3.0). In September 1985, the 1325-N Liquid Waste Disposal Facility was put into service to replace the 1301-N facility.

DOE-RL wishes to make clear its commitment to close the facility under RCRA. Should investigations reveal that significant and non-localized contamination is present at depth, then DOE-RL will begin immediately to initiate physical closure of the facilities or to take other appropriate actions that are consistent with RCRA. Should they become necessary, those activities will be conducted in accordance with common best engineering practices, under the direction of a registered professional engineer and with the approval of the cognizant regulatory authorities; i.e.:

Regional Administrator
Region X
U.S. Environmental Protection Agency
1200 Sixth Avenue
Seattle, Washington 98101

or

Director
Washington Department of Ecology
Mail Stop PV-aa
Olympia, Washington 98504

This closure plan includes general facility information, a description of how the facility will be closed, an estimate of the maximum inventory of waste in storage and/or treatment at any time, a description of steps necessary to decontaminate the facility equipment during closure, a schedule for final closure activity, and an estimate of the expected year of closure. The locations of official copies of the Closure/Post-Closure Plan are given in Appendix F. The person responsible for storing and updating these copies is given in Appendix G. The certification of closure is found in Appendix H.

6.1 Closure Plan

6.1a Closure Performance Standard

This closure plan has been developed using methods and procedures to complete all the activities necessary to close the 1301-N Liquid Waste Disposal Facility located at the U.S. Department of Energy Hanford Site in the 100-N Area. Closure will occur in a manner which will accomplish the following:

- Minimize the need for further maintenance,

- Control, minimize, or eliminate any potential threats to human health and the environment, post-closure escape of dangerous waste, dangerous waste constituents, leachate, contaminated rainfall, and waste decomposition products to the ground, surface water, ground water, and the atmosphere, and

- Return the land to the appearance and use of surrounding land areas to the degree possible given the nature of the previous dangerous waste activity.

6.1b Facility and Process Description

The following description of the 1301-N Liquid Waste Disposal Facility is taken from Diediker and Hall (1985). From the startup of the N Reactor in 1963 until September 1985, the 1301-N facility system was the primary liquid radioactive waste disposal system for N Reactor. Radioactive liquid effluents from the reactor coolant system, spent fuel storage basin, periphery coolant

systems, and various radioactive drain systems throughout the reactor facility were discharged to the 1301-N facility. The 1301-N facility was a ground disposal facility that made use of the natural filtration and ion exchange properties of soil to remove radioactive material from effluent water.

The 1301-N facility is located in the 100-N Area of the Hanford Site (Figure 6-1).

The 1301-N facility is located on the riverbank bluff, some 60 feet above and 860 feet back from the Columbia River. Liquid streams from reactor systems were discharged into a 52-foot by 12-foot concrete trough (weir box) then spilled into a crib (Figure 6-2). The crib itself is a 125-foot by 290-foot rectangular basin, constructed by excavating the existing soil and then surrounding the excavation with a soil and gravel embankment. The bottom of the crib was filled with a 5-foot layer of large stones.

The water level in the crib was maintained well below the surface of the stones by limiting the flow to the crib and using an extension trench connected to the north side of the crib. The extension trench was added onto the crib after only a few years of reactor operation.

The crib extension trench is an excavated ditch approximately 1600 feet long, 50 feet wide, and 12 feet deep, extending in a zigzag pattern (Appendix B). At one point in its use, a wire mesh cover was placed over the entire trench to prevent larger animals and birds from obtaining food, water, or shelter within the radiation area. Early in 1982, a concrete cover was placed over the trench. The cover consisted of approximately 67,500 square feet of precast concrete panels, supported at 36-foot intervals on precast beams set on precast concrete footings. The concrete cover provides protection of contaminated surfaces from wind, mammals, birds, reptiles, and large insects. The sides of the cover were backfilled and shotcreted to prevent most burrowing animals from entering areas beneath the cover. Spaces between the panels were grouted.

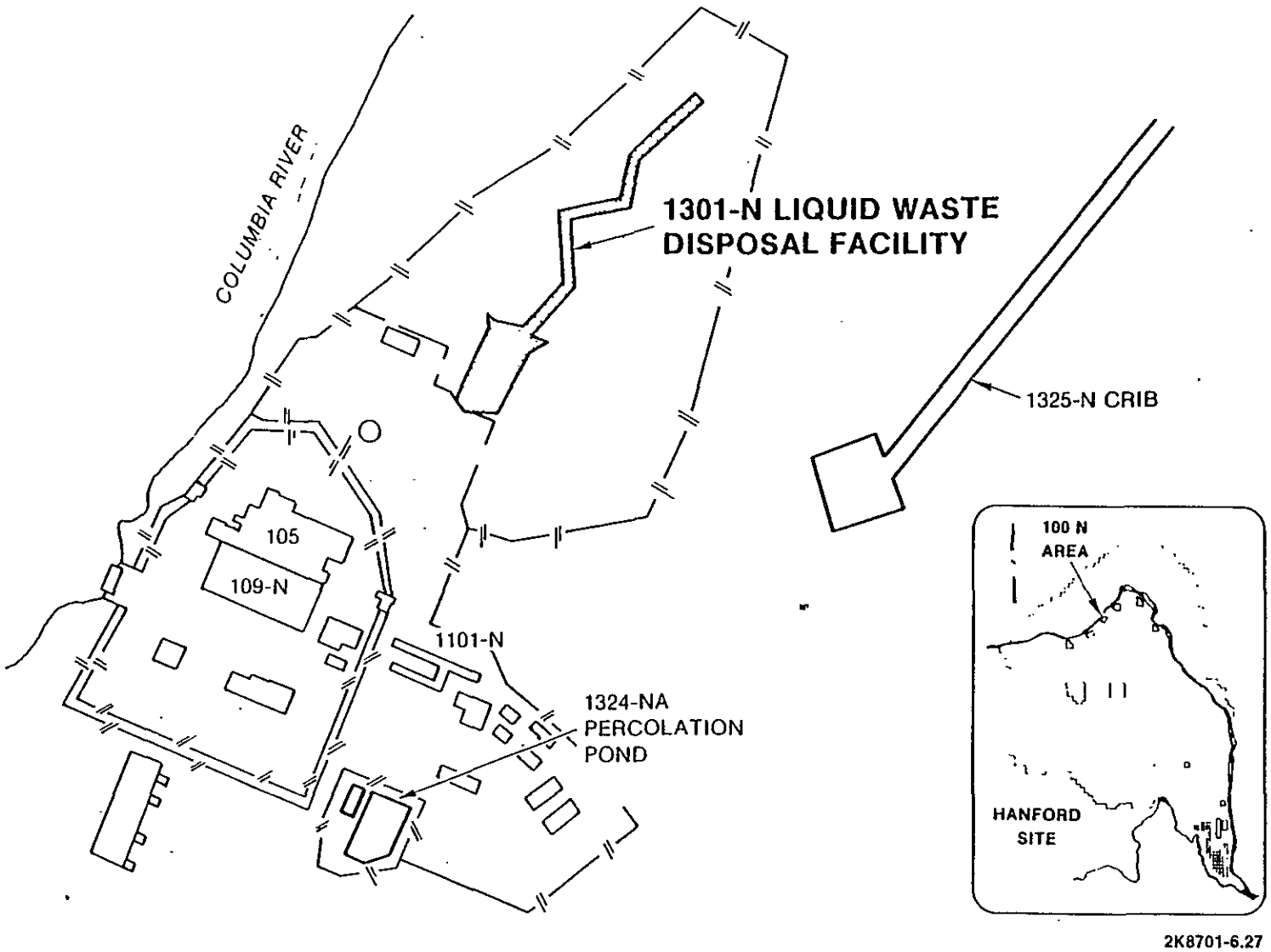


FIGURE 6-1
1301-N LIQUID WASTE DISPOSAL FACILITY AND LOCATION MAP

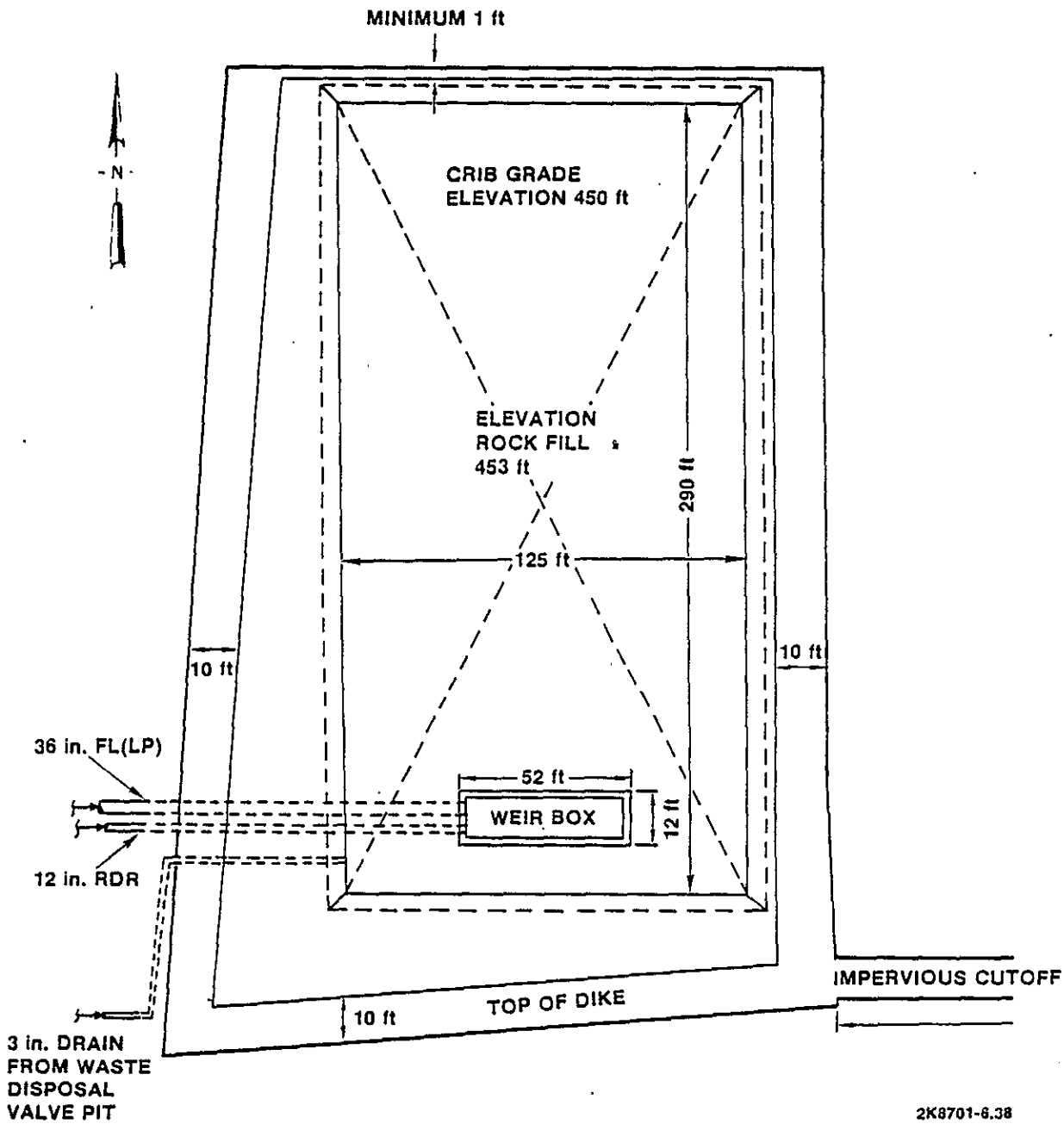


FIGURE 6-2
1301-N CRIB DIAGRAM

The 1301-N facility received low level liquid radioactive wastes containing small quantities of non-radioactive chemical constituents. The estimated volumes of liquids and inventories of radionuclides discharged to the facility from 1964 to 1986 are given in Tables 6-1 and 6-2. The amounts of hazardous chemicals in the wastes disposed in the facility were small in comparison to the radionuclides (Table 5-5). These wastes were generated by laboratories, decontamination activities and other routine activities at N Reactor.

6.1c Partial and Final Closure Activities

It is believed that the radiological hazards of the 1301-N Liquid Waste Disposal Facility far outweigh the possible nonradiological hazardous waste problems. Therefore, it is recommended that the 1301-N facility be closed under the radiological closure plan found in Appendix C (UNC document UNI-3533, "Closure and Post-Closure Plan for the 1301-N and 1325-N Liquid Waste Disposal Facilities"). The closure activities will include the following:

(1) A soil and surface sediment sampling and analysis program. Details of this program are addressed in Section 6.1e(1).

(2) A ground water sampling and analysis program. Details of this program are addressed in Section 6.1e(2).

6.1d Estimate of Maximum Waste Inventory

The maximum waste inventory will be calculated after the soil and ground water characterization programs are completed.

6.1e Facility and Equipment Decontamination Steps

The 1301-N Liquid Waste Disposal Facility has historically received liquid radioactive wastes containing a limited amount of hazardous chemical constituents. Discharges of liquid wastes to the 1301-N facility were discontinued in September, 1985.

TABLE 6-1

CUMULATIVE ESTIMATE OF RADIONUCLIDES DISCHARGED TO THE 1301-N FACILITY

1964 to 1986

Radionuclide	Halflife	Cumulative Inventory (curies)
Co-60	5.3y	10,000
Sr-90	29y	2,700
Ru-106	373d	2,500
Cs-134	2.1d	600
Cs-137	30y	3,400
Pu-239 & 240	24,000y	18

TABLE 6-2

CUMULATIVE ESTIMATE OF RADIONUCLIDE INVENTORY THE IN 1301-N FACILITY

1964 to 1986

Radionuclide	Halflife	Cumulative Inventory (curies)
Co-60	5.3y	3,800
Sr-90	29y	1,800
Ru-106	373d	120
Cs-134	2.1d	51
Cs-137	30y	2,300
Pu-239 & 240	24,000y	18

Because of past disposal practices, the possibility exists that contamination of soil and ground water by hazardous wastes has occurred. This contamination would be located vertically below the 1301-N facility. To determine the extent and concentration of the hazardous constituents in the soil and/or ground water, a soil and ground water sampling program will be implemented. If the environmental media are determined to be significantly contaminated, the closure plan will be amended, and resubmitted to the appropriate regulatory agency.

6.1e(1) Soil

The present radiological hazards associated with the 1301-N facility require UNC to conduct a study to determine the feasibility of a soil sampling program. This study will address the following considerations:

(a) The ability for a sample team to collect the samples. This section will require a review of:

1) The radiological exposure incurred by the sampling team.
2) The special sampling equipment and training needed.
3) The proper safety procedures.

(b) The ability to obtain a representative sample since radiological shipping restrictions and personal exposure limitations may limit the sample size.

(c) The ability to find an analytical laboratory that could conduct the required analyses.

It is proposed to conduct this feasibility study and complete a written report on the findings by September 30, 1987.

6.1e(2) Ground Water

Three new shallow ground water monitoring wells will be installed, adding to the existing monitoring system at the 1301-N facility. One well will be located up gradient and two will be down gradient of the 1301-N Liquid Waste Disposal Facility. In Phase II these wells will be sampled and the samples tested at an analytical laboratory for the parameters referenced in Section 5.5c(2). Samples from selected wells will be analyzed for the parameters listed in WAC 173-303-9905 (Appendix E). Samples from selected wells (based on Phase I) will be collected and analyzed in addition to samples from the new wells on a monthly basis until a data base is established. Once the data base is developed and reviewed, a more site specific list of analytical parameters will be established. Test results will be compared to background levels of each parameter. If the test results are higher than background levels, the ground water will be considered contaminated and corrective action at the facility will be implemented or alternate concentration levels will be developed. Procedures in the PNL-MA-580, Environmental Monitoring Procedures Manual, will be used during the ground water monitoring program. This manual contains detailed descriptions of ground water sampling and quality assurance/quality control procedures. Assuming that the routine ground water monitoring program does not show any ground water contamination the sampling schedule below will be followed.

(a) Monthly, until a data base is established (using WAC 173-303-9905 List).

(b) Quarterly for one year (using site specific list of analytical parameters).

(c) Annually for the following three years (using site specific list of analytical parameters).

(d) Discontinue sampling after the third year of annual sampling.

Section 5.5c(2) of this permit application contains a complete list of testing parameters.

6.1e(3) Equipment and Facilities

Decontamination of the facility equipment will be conducted. Any equipment radioactively contaminated during closure, such as a tracked bulldozer, roadgrader, dump trucks, water truck, etc., will be decontaminated after it is no longer required for waste handling. The equipment will be steam cleaned at the 1301-N facility to remove the radioactive contamination.

Decontamination of the facility may not be possible. The present radiological hazard may require that the 1301-N Liquid Waste Disposal Facility be stablilized with a protective barrier as addressed in the document UNI-3533, "Closure and Post-Closure Plan for the 1301-N and 1325-N Liquid Waste Disposal Facilities" (Appendic C). This barrier may consist of crushed rock or gravel, a synthetic liner or geotextile, and seeded topsoil. An alternative barrier would be to cover the crushed rock layer with 1-2 inches of concrete.

6.1f Schedule for Closure

The estimated year of final closure of the 1301-N Liquid Waste Disposal Facility will be established upon acceptance of a Closure Plan by WDOE or EPA. DOE-RL expects to begin final closure after notice of acceptance.

6.1g Amendments to Closure Plans

This closure plan will be amended whenever changes in operating plans or facility design effect the plan, whenever there is a change in the year of closure, or if the soil and/or ground water surrounding the ponds are found to be contaminated by nonradioactive hazardous wastes. Any amendments to this closure plan will be submitted to the appropriate regulatory agency for approval.

6.1h Certification of Closure

Upon final closure of the 1301-N Liquid Waste Disposal Facility, DOE-RL will submit to the appropriate regulatory agency a certification (Appendix H), signed by both DOE-RL and an independent registered professional engineer, stating that the facility has been closed in accordance with the approved closure plan.

6.2 Post-Closure Plan

It is believed that the radiological hazards far outweigh the possible non-radiological hazardous waste problems at the 1301-N Liquid Waste Disposal Facility. The radioactive waste will require post-closure maintenance and surveillance. Therefore, it is recommended that the post-closure care for the 1301-N facility follow the guidance addressed in the document UNI-3533, Closure and Post-Closure Plan for the 1301-N and 1325-N Liquid Waste Disposal Facilities (Appendix C). This document addresses permanent markers, maintenance, and surveillance programs to be established for the 1301-N facility post-closure period.

If the soil and/or ground water underlying the facility is found to be significantly contaminated by nonradioactive hazardous wastes, an amended closure and post-closure plan will be developed and submitted to the appropriate agency.

6.3 Notice to Local Land Authority

The DOE-RL will file, within 90 days after the start of the closure period, the following documents or similar documents to the local land use authority and the regulating authorities (WDOE and EPA). The land use authority is the Benton County Planning Department located at the Courthouse Building, Prosser, Washington 99350.

a. A survey plat indicating the location and dimensions of facility to the extent the information exists and with respect to permanently surveyed bench marks will be submitted. This plat will be prepared by a certified professional land surveyor.

b. The following note is to accompany the survey plat: This plat describes real property in which hazardous wastes have been disposed in accordance with requirements of 40 CFR Part 265.116 and 265.119. Although this hazardous waste disposal facility is now closed, public health, environmental safety, and regulations issued by the EPA in 40 CFR 265.119

require that post-closure use of the property never be allowed to disturb the integrity of the final cover unless it can be demonstrated that any proposed disturbance will not increase the risk to the human health or the environment.

c. A record of the type, location, and quantity of hazardous wastes disposed of within the facility to the extent that the information exists will be submitted. During the post-closure care period, any changes to this record will be submitted to the regulating authority.

6.4 Notice in Deed to Property

The DOE-RL will, in accordance with state law, sign, notarize, and attach the following notation to the deed within 180 days of the start of the post-closure care period.

TO WHOM IT MAY CONCERN:

The U.S. Department of Energy-Richland Operations Office, an operations office of the U.S. Department of Energy, which is a Department of the United States Government, the undersigned, whose local address is the Federal Building, 825 Jadwin Avenue, City of Richland, County of Benton, State of Washington, hereby gives the following notice as required by 40 CFR 119.

a. The United States of America is, and since April 1943, has been in possession in fee simple of the following described lands (legal description).

b. Since November 19, 1980, the U.S. Department of Energy-Richland Operations Office has disposed of hazardous and/or dangerous waste under the terms of regulations promulgated by the United States Environmental Protection Agency and/or Washington Department of Ecology to the above-described land.

c. The future use of the above-described land may not be restricted under the terms of 40 CFR 265.117(c), but may be restricted due to possible hazards associated with radionuclides.

d. Any and all future purchasers of this land should inform themselves of the requirements of the regulations and ascertain the amount and nature of wastes disposed on the above-described property.

e. U.S. Department of Energy-Richland Operations Office have filed a survey plat with the Benton County Planning Department and with the United States Environmental Protection Agency, Region X and/or Washington Department of Ecology showing the location and dimensions of landfill cells and a record of the type, location and quantity of waste disposal within each area of the facility.

6.5 Closure Cost Estimate

This section is not applicable because federal facilities are exempt from this section per 40 CFR 265.140(c).

6.6 Financial Assurance Mechanism for Closure

This section is not applicable because federal facilities are exempt from this section per 40 CFR 265.140(c).

6.7 Post-Closure Cost Estimate

This section is not applicable because federal facilities are exempt from this section per 40 CFR 265.140(c).

6.8 Financial Assurance Mechanism for Post-Closure Care

This section is not applicable because federal facilities are exempt from this section per 40 CFR 265.140(c).

6.9 Liability Requirements

This section is not applicable because federal facilities are exempt from this section per 40 CFR 265.140(c).

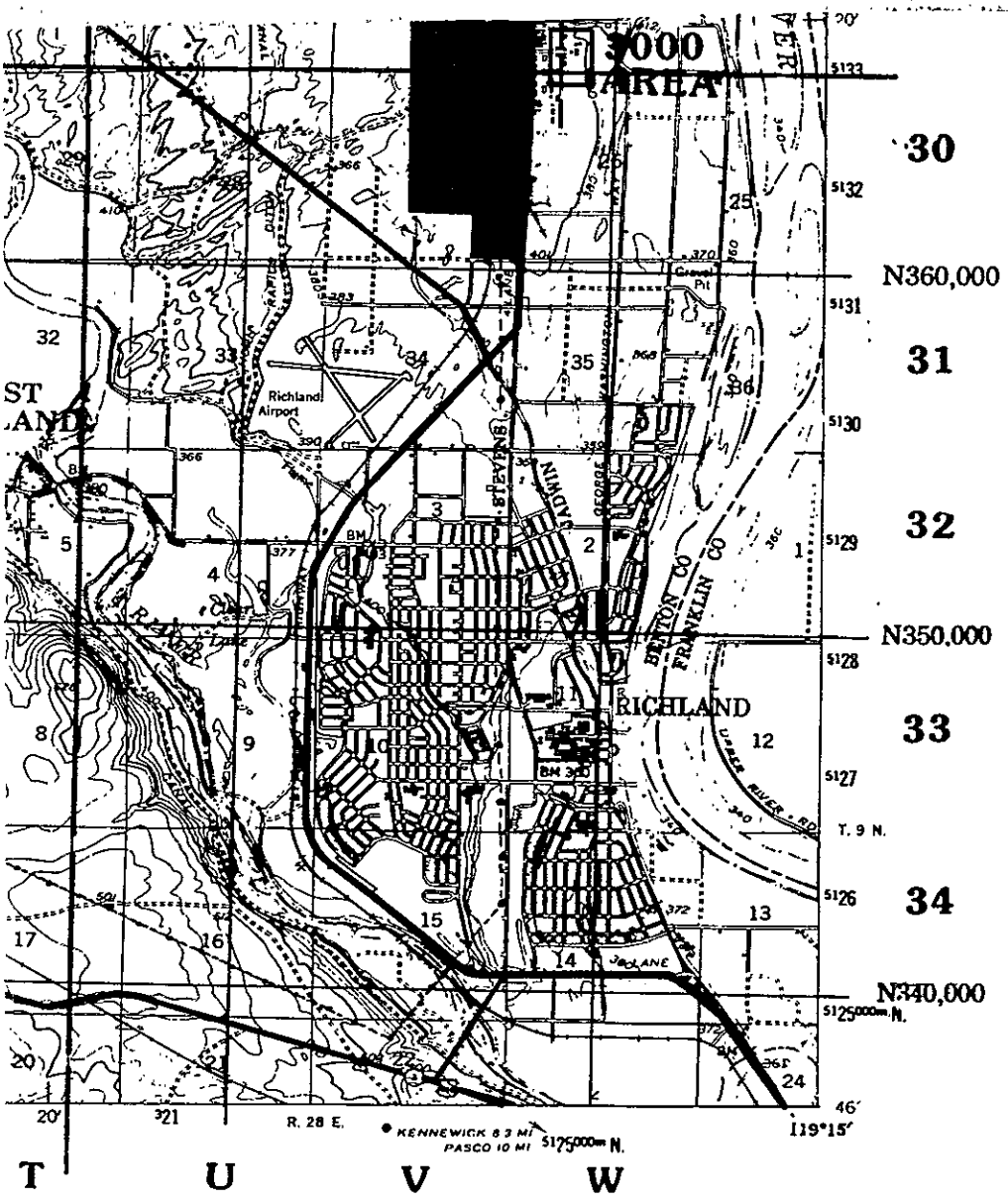
6.10 References

See Appendix D.

WP# 9120A

APPENDIX A

HANFORD SITE MAP,
100-N AREA TOPOGRAPHIC MAP
AND HANFORD GROUNDWATER TABLE MAP



G APPROVALS	DATE
QUALITY ASSURANCE	
P. Mallett	1/18/85
LE ENGINEER	
ARTELL	1/18/85
Mallett	1/18/85
	1/18/85
	1/18/85

U. S. Department of Energy
Richland Operations Office

M

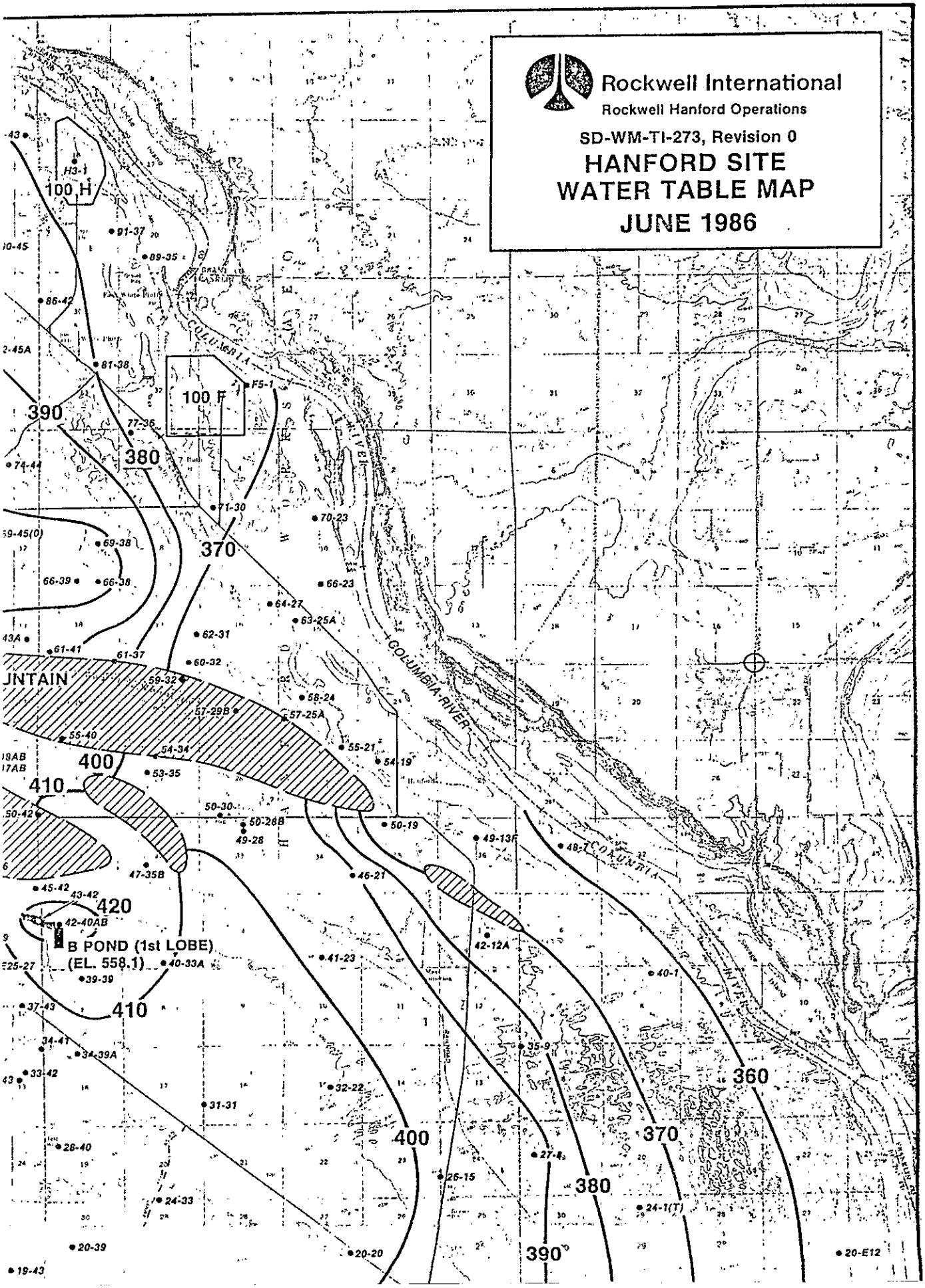
Rockwell Hanford Operations
Richland, Washington 99352

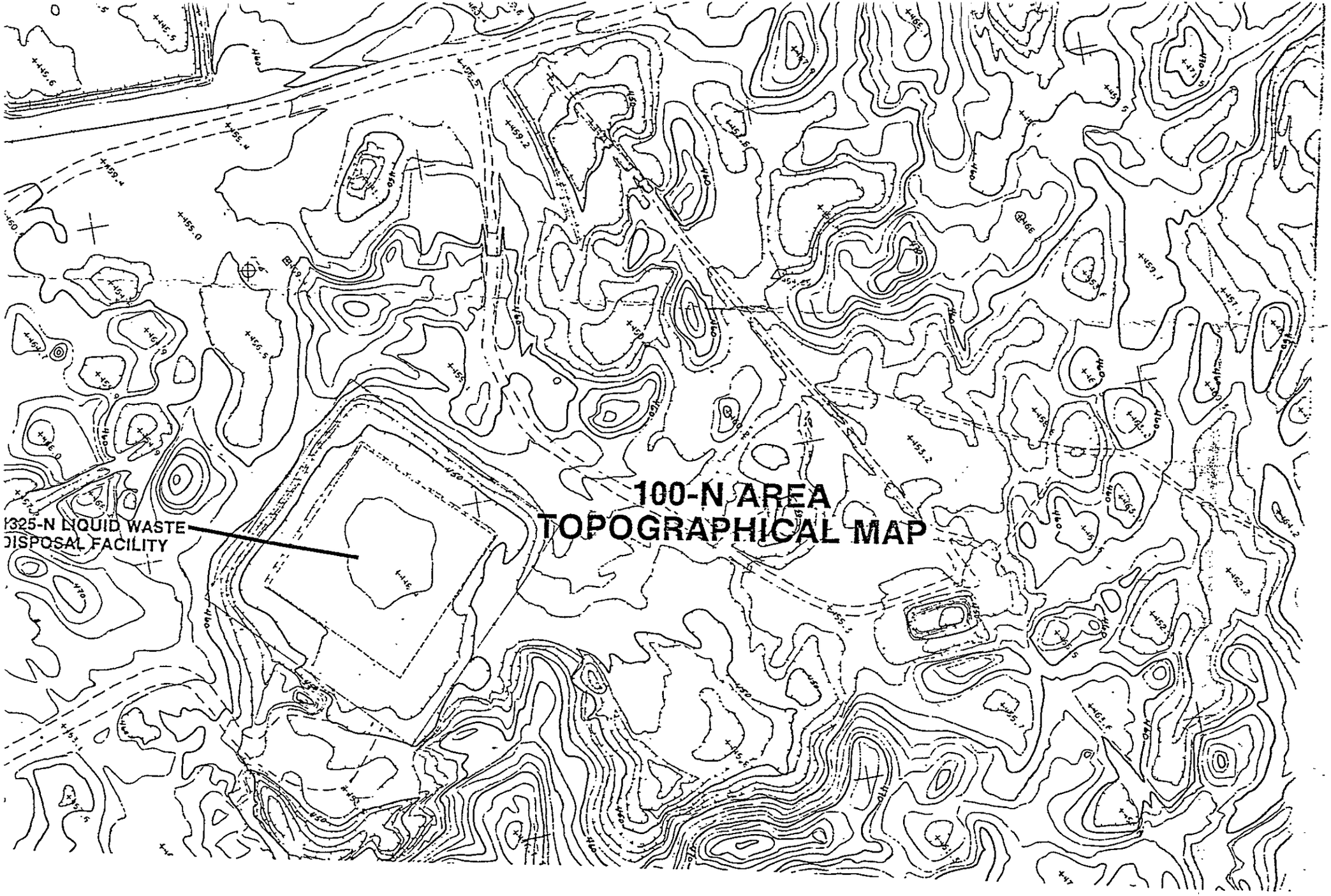
HANFORD SITE MAP

H

SCALE	BLDG NO.	INDEX NO.
AS SHOWN	600 GEN	0100

TION	BY	DRAWING NO	SHEET NO.	SHEETS
NE	NOT REQ'D	H-6-951	1	1


Rockwell International
Rockwell Hanford Operations
SD-WM-TI-273, Revision 0
HANFORD SITE
WATER TABLE MAP
JUNE 1986
100 H
100 F
H3-1
F5-1
COLUMBIA RIVER
GOLUMBIA-RIVER
B POND (1st LOBE)
(EL. 558.1)
390
380
370
400
410
420
360
91-37
89-35
86-42
81-38
77-36
74-44
71-30
70-23
69-38
66-39
66-38
66-23
64-27
63-25A
62-31
61-41
61-37
60-32
59-32
58-24
57-29B
57-25A
55-40
54-34
55-21
54-19
53-35
50-30
50-26B
49-28
50-19
49-13F
48-1
47-35B
46-21
45-42
43-42
42-40AB
42-12A
41-23
40-33A
40-1
39-39
37-43
35-9
34-41
34-39A
33-42
32-22
31-31
28-40
27-8
26-15
24-33
24-1(T)
20-39
20-20
20-E12
19-43


100-N AREA
TOPOGRAPHICAL MAP
1325-N LIQUID WASTE
DISPOSAL FACILITY

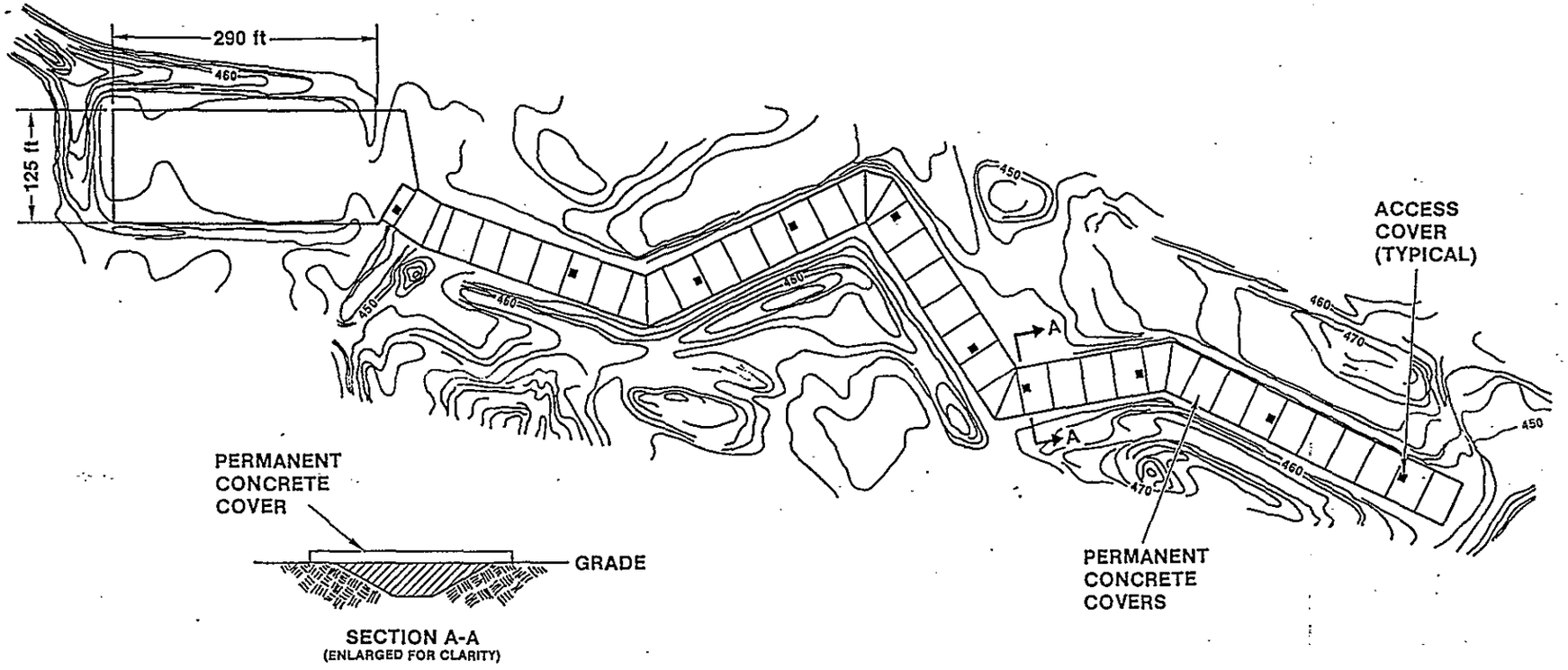
APPENDIX B

PLAN OF 1301-N CRIB AND TRENCH

APPENDIX C

CLOSURE AND POST-CLOSURE PLAN FOR THE 1301-N AND 1325-N LIQUID WASTE DISPOSAL FACILITIES

1301-N LIQUID WASTE DISPOSAL FACILITY



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A UNC RESOURCES Company

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UNDER CONTRACT NUMBER DE-AC06-76RL01857

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UNI-3533

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Title

CLOSURE AND POST-CLOSURE PLAN FOR THE 1301-N AND 1325-N LIQUID WASTE DISPOSAL FACILITIES

Author

L. P. Diediker and J. A. Hall

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18. DR Pratt	1118N/32/C8		
19. KM Probasco	1114N/28/S3		
20. DL Renberger	1117N/14/C1		
21. VR Richards	1114N/19/S3		
22. DJ Rokkan	1114N/18/S3		
23. WG Ruff	1117N/16/C2		
24. JW Uhler	1117N/28/C8		

ROUTE TO	PAYROLL NO.	LOCATION	FILES ROUTE DATE	SIGNATURE AND DATE

UNC NUCLEAR INDUSTRIES, INC.

RICHLAND, WA 99352

NOTICE

DISCLAIMER

11 UNI-3533

CLOSURE AND POST-CLOSURE PLAN
FOR THE
1301-N AND 1325-N LIQUID WASTE DISPOSAL FACILITIES

Prepared by: _____ Date: 10-18-85
J. A. Hall, Environmental Engineer
Radioactive Effluent Control Subsection

Reviewed by: _____ Date: 10-18-85
L. P. Diediker, Manager
Radioactive Effluent Control Subsection

Reviewed by: _____ Date: 10-21-85
J. J. Dorian, Manager
Environmental & Emergency Preparedness Section

Approved by: _____ Date: 10-29-85
D. F. Brendel, Director
Safety & Environmental Engineering Department

SUMMARY

Closure and post-closure plans for the 1301-N and 1325-N Liquid Waste Disposal Facilities are provided in this report in accordance with the requirements of DOE Order 5820.2, "Radioactive Waste Management." UNC's commitment for these plans in the Hanford Site Implementation Plan to the subject order was November 1986. These plans are prepared now to provide guidance in determining definitive design requirements for interim stabilization of the 1301-N facility.

The plans include descriptions and operating histories of the 1301-N and 1325-N facilities to give an appreciation for the scope of the effort required to "close" the facilities. Assumptions and considerations are next provided in order to place boundary conditions on the requirements of the plan. Any change in a boundary condition would necessitate a re-evaluation of elements in the plan.

Because of limiting considerations, including working dose levels and the current need to keep the 1301-N facility in a standby mode, the closure plans are divided into two categories: interim stabilization and permanent closure. Interim stabilization involves placing the 1301-N facility in an acceptable radiological condition while still maintaining its ability to operate as a standby facility. Interim stabilization methods will not preclude permanent closure options, which represent the final disposition of the facilities.

Permanent closure is divided into two possible cases. These cases are dependent upon a radiological (and possibly hazardous waste) characterization of the 1301-N and 1325-N facilities and their respective underlying soil columns. Depending upon the characterization results, one case would require removal of contaminated components, and the other in-situ isolation of the contamination. For 1301-N, the limited characterization to be completed by the end of March 1986 on the 1301-N trench surface sediments should allow determination of the appropriate permanent closure case. Finally, post-closure (during institutional control) requirements are delineated.

TABLE OF CONTENTS

1.0 INTRODUCTION

DOE Order 5820.2, "Radioactive Waste Management" requires a site-specific comprehensive closure plan for Low Level Waste (LLW) disposal facilities. The plan shall be reviewed and, if necessary, amended prior to initiation of closure activities to assure that the objectives of the DOE Order are met. This document, UNI-3533, will serve as a closure plan for the 1301-N and 1325-N Liquid Waste Disposal Facilities. It will be amended as definitive requirements are imposed by regulatory agencies (i.e., DOE, EPA, and the State of Washington.)

Currently, the only LLW disposal sites operated by UNC that require closure and post-closure plans are the 1301-N and 1325-N Liquid Waste Disposal Facilities. UNC has committed, in the Implementation Plan for Hanford Site Compliance to DOE Order 5820.2, Radioactive Waste Management, to completing the closure plan for these facilities by the end of CY 1986. This closure plan is being prepared in advance so that proposed interim closure work can be planned and budgeted for as soon as possible. Aspects of the plan should be used in determining definitive design requirements for interim stabilization of the 1301-N facility and future planning for permanent closure of the 1301-N and 1325-N facilities.

2.0 Facility Descriptions and Operating Histories

2.1 1301-N Liquid Waste Disposal Facility

Up until September 1985, the 1301-N facility system was the primary liquid rad-waste disposal system for N Reactor. Radioactive liquid effluents from the reactor coolant system, spent fuel storage basin, periphery coolant systems, and various radioactive drain systems throughout the reactor facility were discharged to the 1301-N facility. The 1301-N facility is a ground disposal facility that makes use of the natural filtration properties of soil to remove radioactive material from effluent water.

The 1301-N facility is located on the riverbank bluff, some 60 feet above and 860 feet back from the Columbia River. Liquid streams from reactor systems were discharged into a 52-foot by 12-foot concrete trough (weir box) then spilled into a crib (see Figure 1). The crib itself is a 125-foot by 290-foot rectangular basin, constructed by excavating the existing soil and then surrounding the excavation with a soil and gravel embankment. The bottom of the crib was filled with a 3-foot layer of large stones.

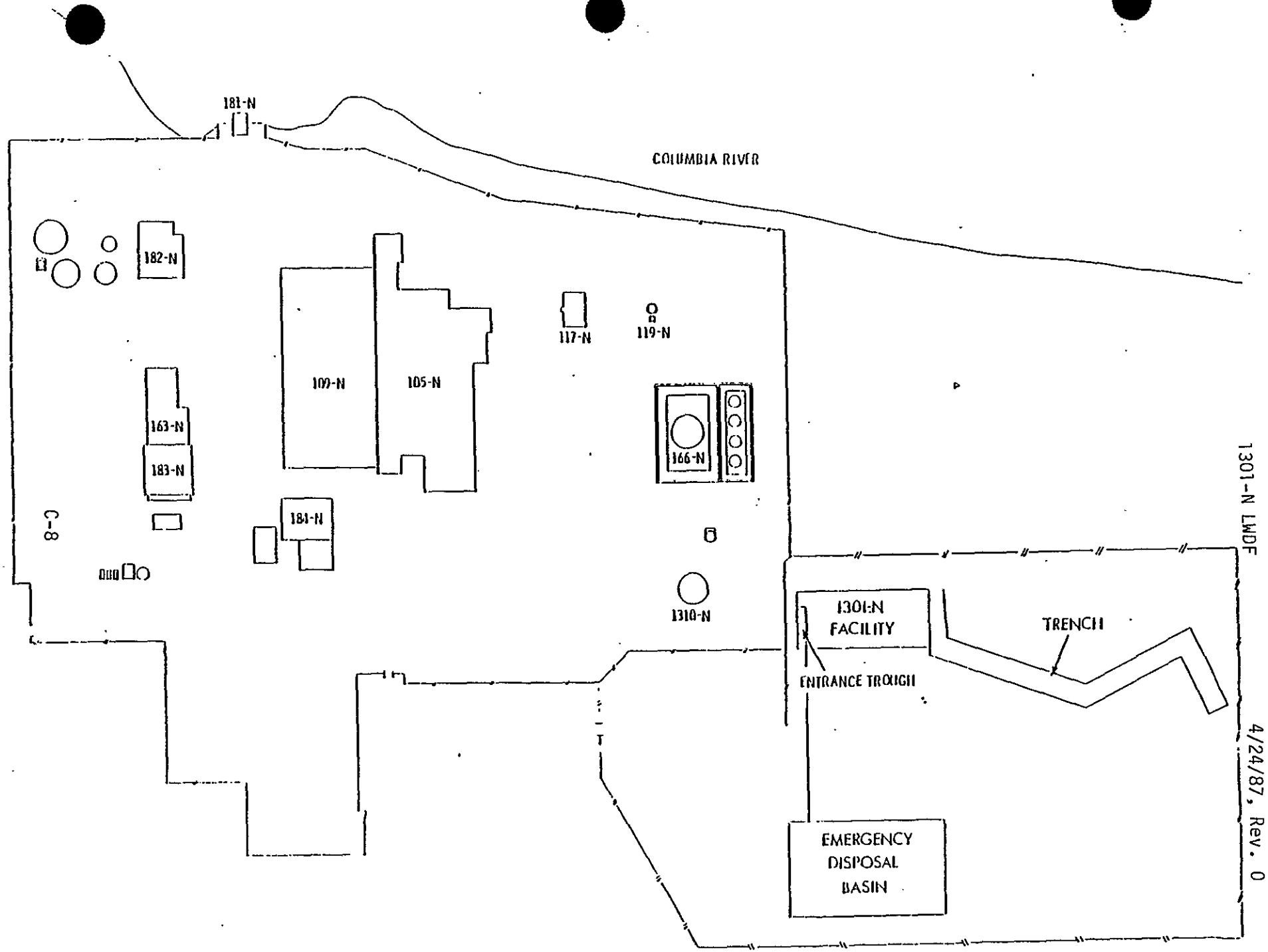


FIGURE 1 1301-N Facility Layout

The water level in the crib was maintained well below the surface of the stones by limiting the flow to the crib and using an extension trench connected to the north side of the crib. The extension trench was added onto the crib after only a few years of reactor operation.

Early in 1981, a layer of additional rock was added to the area surrounding the weir box (see Figure 2). The added rock was necessary for contamination control purposes. The added cover was 12 to 24 inches in depth using cobbles sized from 12 to 24 inches.

The crib extension trench is an excavated ditch approximately 1600 feet long, 50 feet wide, and 12 feet deep, extending in a zigzag pattern. At one point in its use, a wire mesh cover was placed over the entire trench to prevent larger animals and birds from obtaining food, water, or shelter within the radiation area. It was later determined, however, that the screen was inadequate, and early in 1982, a cover was placed over the trench. The cover consisted of approximately 67,500 square feet of precast concrete panels, supported at 36-foot intervals on precast beams set on precast concrete footings. The concrete cover provides protection of contaminated surfaces from wind, mammals, birds, reptiles, and large insects. The sides of the cover were backfilled and shotcreted to prevent most burrowing animals from entering areas beneath the cover. Spaces between the panels were grouted.

2.2 1325-N Liquid Waste Disposal Facility

During 1982, routine sampling of the riverbank springs indicated an increase in radionuclide concentrations reaching the river. This condition pointed to a decrease in the effectiveness of the 1301-N crib and trench to retain radionuclides in the soil column. The 1325-N crib was constructed as a replacement liquid rad-waste disposal facility for the 1301-N facility.

The 1325-N crib system consists of a tie-in reinforced concrete diversion box (to the 1301-N weir box), a reinforced concrete header box that distributes the effluent to the covered crib, and approximately 1200 feet of 36-inch diameter pipeline connecting the diversion box to the header box. The crib is approximately 1000 feet east and 200 feet north of the 1301-N crib. The crib provides a percolation surface measuring approximately 250 feet by 240 feet and is covered with precast, prestressed concrete panels sealed with grout. The crib cover is approximately 10 feet lower than the surrounding ground and less than five feet above the percolation surface. Rock stabilization materials were used on the slopes around the crib to minimize wind erosion.

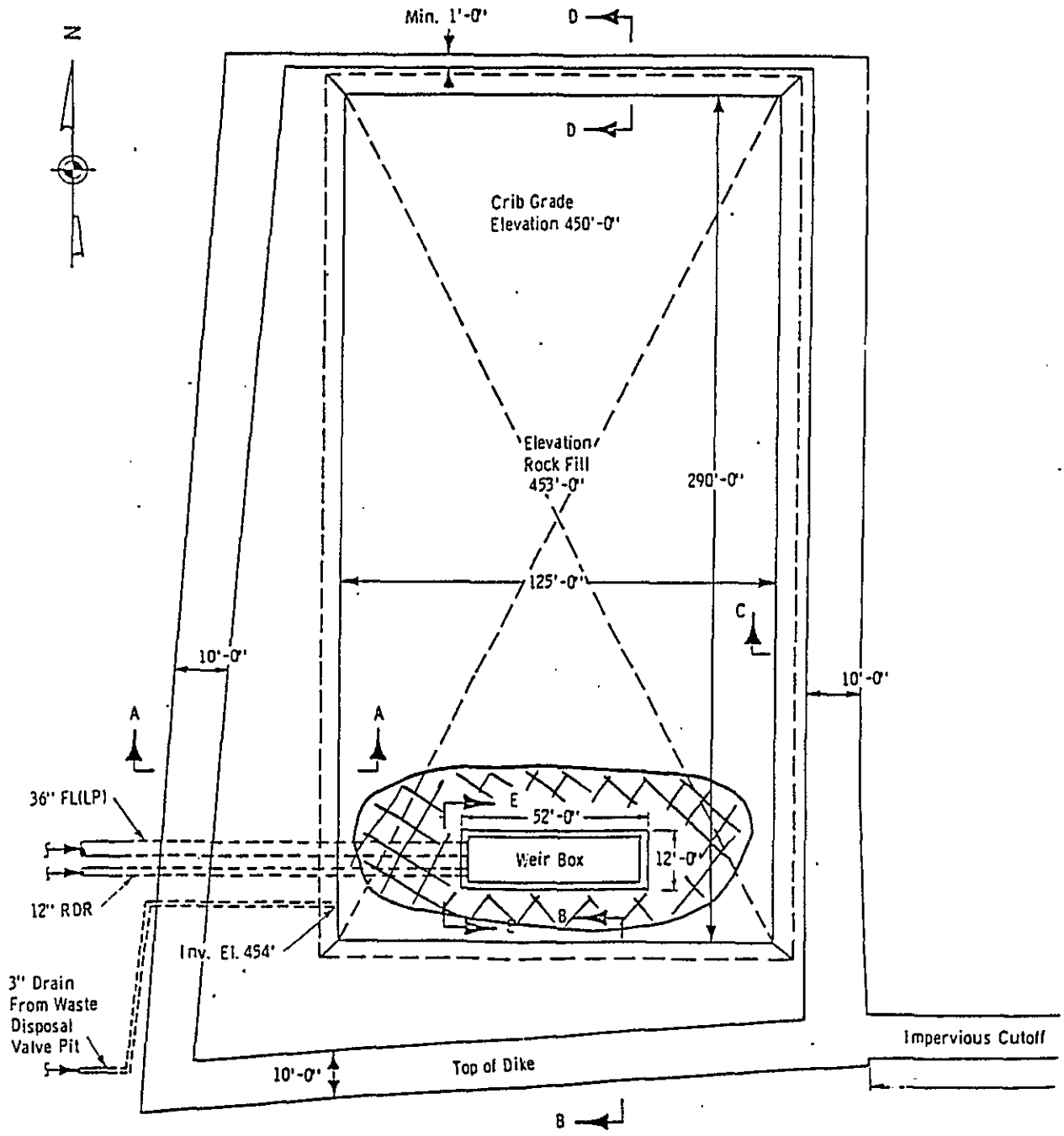


Figure 2
1301-N Crib Plan
Showing Cobble Addition Area

Because of flow limitations with the 36-inch pipeline connecting the 1301-N and 1325-N facilities, approximately 80,000 gallons of effluent would overflow the 1301-N weir box into the 1301-N crib during a design reactor decontamination (UNI-2105). This decontamination flow would consist, however, of radiologically cleaner flush water only.

After a short period of operation, it was determined that the 1325-N crib was able to handle far less than its design flow rate. An extension trench was added and placed into service in September of 1985 to augment the operational capacity of the 1325-N crib.

The trench ties into the crib at two points (from the crib's northern and eastern corners) with the effluent from each combining in a common weir box. The tie-in is composed of rubber gasket-joined, precast, reinforced, concrete box sections. From the weir box the trench extends about 3000 feet in a north-northeasterly direction. The trench is covered with prestressed, precast, double-tee concrete panels approximately 55 feet across and 10 feet wide placed on concrete footings. The panels, placed close together, were left unsealed and contain lifting lugs. Both features facilitate panel removal. Two foot high, eight-inch centra-core concrete panels are placed (unsealed) along the side of the trench, mating with the trench cover panels. The sides of the trench are then backfilled, providing a minimum barrier distance of three feet to burrowing animals.

The seven-foot deep trench is divided into four equal sections by three dams (in addition to the weir box) composed of structural fill and concrete. A layer of riprap was added on the downstream side of each dam to prevent scouring. The top two feet of the trench bottom was screened to remove fines to aid in preventing trench plugging. The 1325-N facility can hold six million gallons. (See Figure 3 for the 1325-N facility layout.)

2.3 Operating Histories

Water discharged to the crib and trench systems percolates through the underlying soil to an unconfined aquifer in communication with the Columbia River. Through the movement of water in the ground underlying the crib and trench, radioactive materials are retained in the soil by precipitation and ion exchange reactions. Additional loss of radioactive material occurs by decay of the shorter-lived radionuclides in the discharge water during their transit to the river.

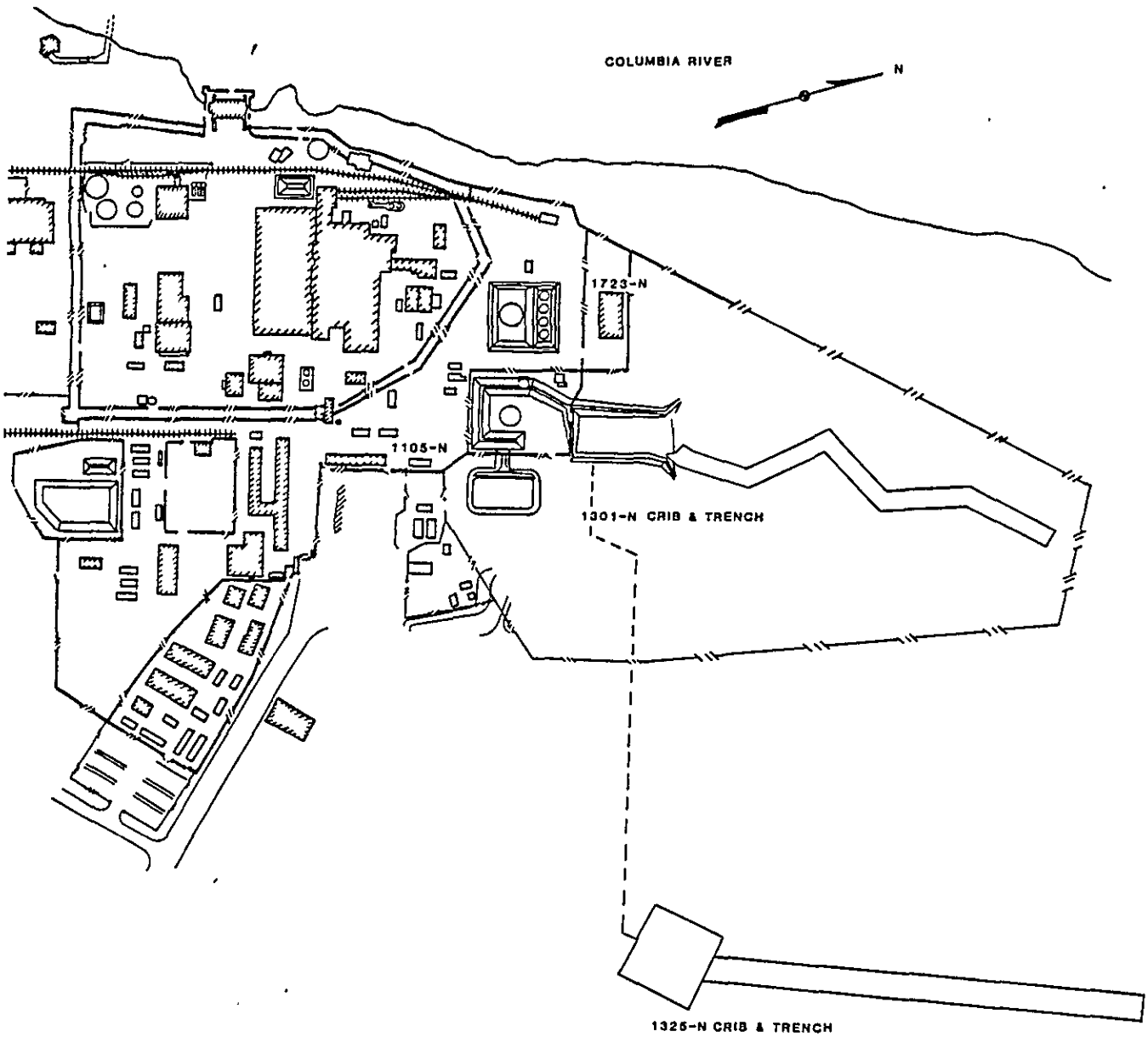


Figure 3

1325-N Facility Layout

Hydrological analyses have indicated that flow pathways to the river are a complex system in that the water may enter the river from beneath the river bed or from springs on the river shoreline, and that the pathways may lead directly to the river, or may parallel the river for several miles before entry. Radionuclide sampling studies have shown that the most radioactive spring water enters the river via the shortest crib-to-river pathway. Figure 4 illustrates the results of an evaluation of hydrological factors influencing the flow pathways from the crib to the river using a mathematical simulation technique. Figure 5 depicts a cross-sectional view of the 1301-N facility. This information is important for use in devising a characterization program for estimating the areal extent of subsurface contamination.

The variation in removal capability for different radionuclides is dependent on the half-life and the chemical properties of the radionuclide involved. Table 1 gives results from a study performed to determine the physicochemical composition of radionuclides discharged to the crib.

In the study, radionuclides were partitioned into their particulate, cationic, anionic, and nonionic fractions. Since the 1301-N and 1325-N facilities utilize a natural soil column composed of sand (particulate filtration) and clay (cation exchange), the columns are noticeably more effective for radionuclides predominantly in the particulate and cationic forms. The predominantly anionic and nonionic species such as iodine, ruthenium, and antimony are removed by the soil column to a lesser extent than the particulate and cationic radionuclides such as iron, cesium, zirconium, and manganese. Figure 6 shows a schematic of relative radionuclide retention in Hanford soil.

Some radionuclides exhibit characteristics indicating a mixture of the various physicochemical forms. Radionuclides of this type emerge at the river springs in essentially anionic and nonionic forms as their particulate and cationic fractions are retained by the soil column. Tritium, which is chemically indistinguishable from water, is not removed during its transit to the river.

The discharge of radioactive liquids to the 1301-N facility, since N Reactor startup in 1963 up to September of 1985, has resulted in the accumulation of significant quantities of long-lived radionuclides in the soil on the bottom of the facility. The 1325-N facility started receiving part of the N Reactor effluent flow in 1983. Table 2 provides annual release information for the 1301-N and 1325-N facilities through 1984. Table 3 provides cumulative inventory information for the 1301-N and 1325-N facilities with the bulk of the inventory being in 1301-N. For both tables, only the long-lived (half lives greater than one year) radionuclides are shown. Table 4 provides data on sediment sample analysis results from the 1301-N facility trench.

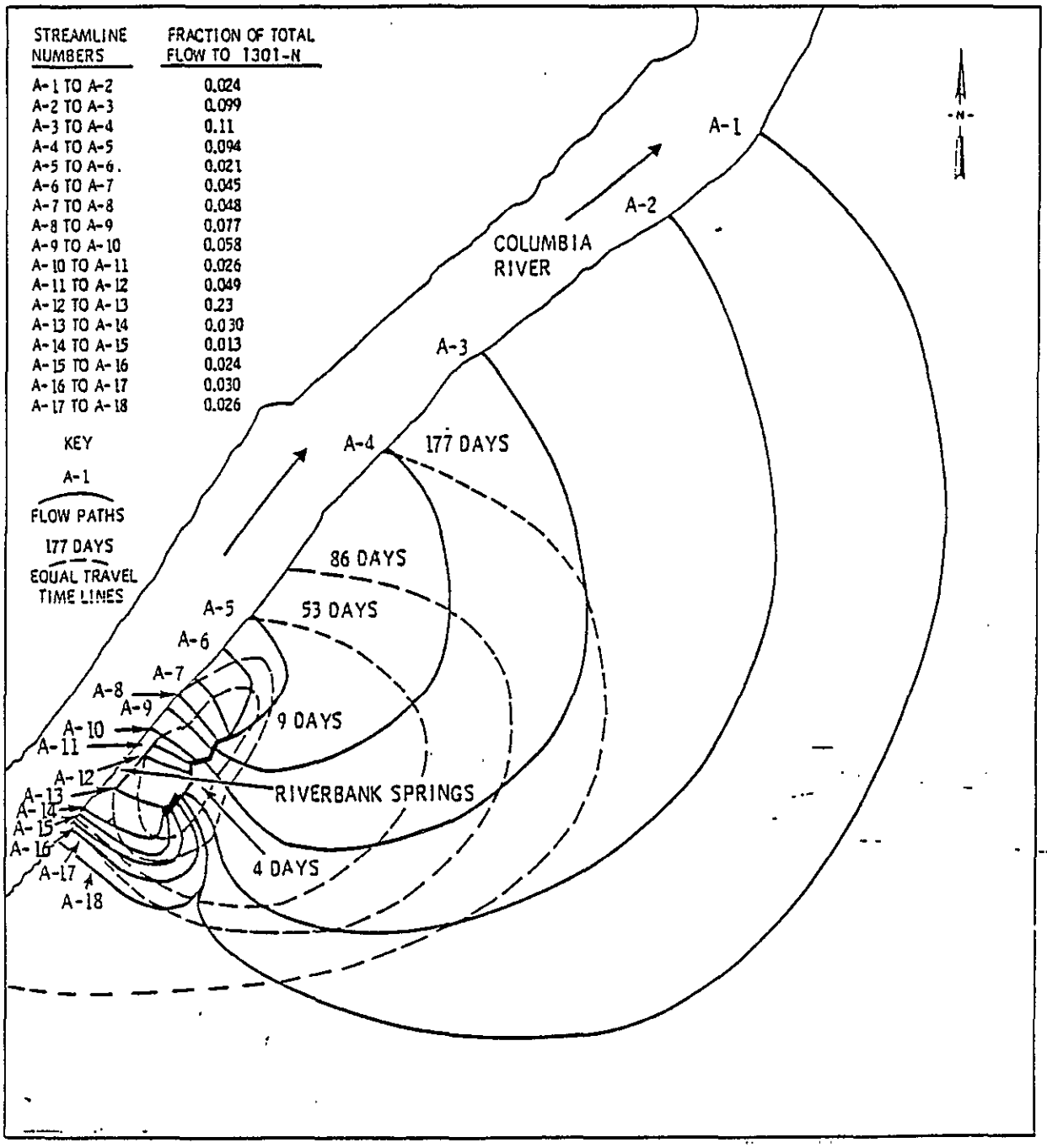


FIGURE 4 Calculated Flow Paths Originating from the 1301-N Facility with Travel Time Lines

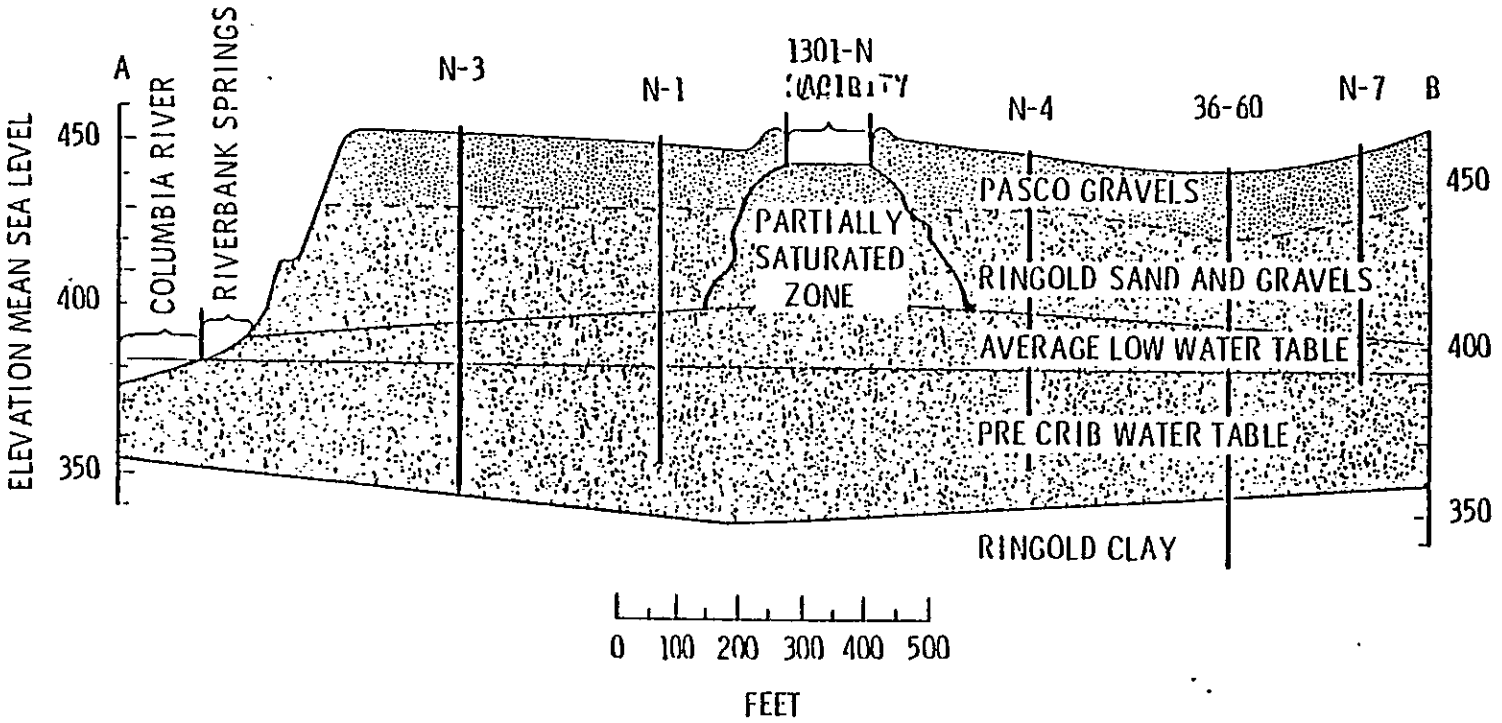


FIGURE 5 Cross Section of the 1301-N Facility

TABLE 1 Physicochemical Characteristics of Radionuclides in Liquid Effluents Discharged to the 1301-N[a] Facility (Percent of Total)

MEASURED RADIONUCLIDE	APPROXIMATE HALF-LIFE	PARTICULATE	CATIONIC	ANIONIC	NONIONIC
Sc-46	84 d.	64	23	11	3.0
Cr-51	28 d.	85	6.7	7.7	.83
Mn-54	300 d.	10	89	.20	.34
Fe-59	45 d.	98	.70	1.3	.35
Co-58	71 d.	93	4.8	2.3	.14
Co-60	5.2 yr.	49	49	.98	.83
Zn-65	245 d.	24	77	1.3	.35
As-76	26 hr.	3.0	7.2	70	20
Sr-91	10 hr.	7.7	86	6.0	.39
Zr-95	66 d.	81	5.7	11	2.5
Nb-95	35 d.	41	47	8.0	4.5
Zr-97	17 hr.	81	9.4	5.6	3.8
Mo-99	67 hr.	.32	3.3	94	2.4
Ru-103	40 d.	66	17	13	4.6
Ru-106	1 yr.	17	49	30	4.7
Sb-122	3 d.	17	11	48	23
Sb-124	60 d.	29	35	23	13
Sb-125	2.7 yr.	23	46	18	13
I-131	8 d.	.39	19	79	1.7
I-133	20 hr.	.33	21	78	1.5
I-135	7 hr.	6.3	31	61	1.1
Cs-134	2 yr.	13	85	1.4	.08
Cs-137	30 yr.	15	85	.41	.03
Ba-140	13 d.	4.5	89	.46	5.6
La-140	40 hr.	6.3	93	.34	.41
Ce-141	33 d.	63	29	6.1	2.1
Ce-144	284 d.	50	42	5.0	3.0
Pm-151	28 d.	9.0	62	14	15
W-187	24 hr.	85	7.7	5.9	1.6
Np-239	2 d.	26	70	3.2	.42

(a) Ref.

Figure 6

Radionuclide Retention in Hanford Soil

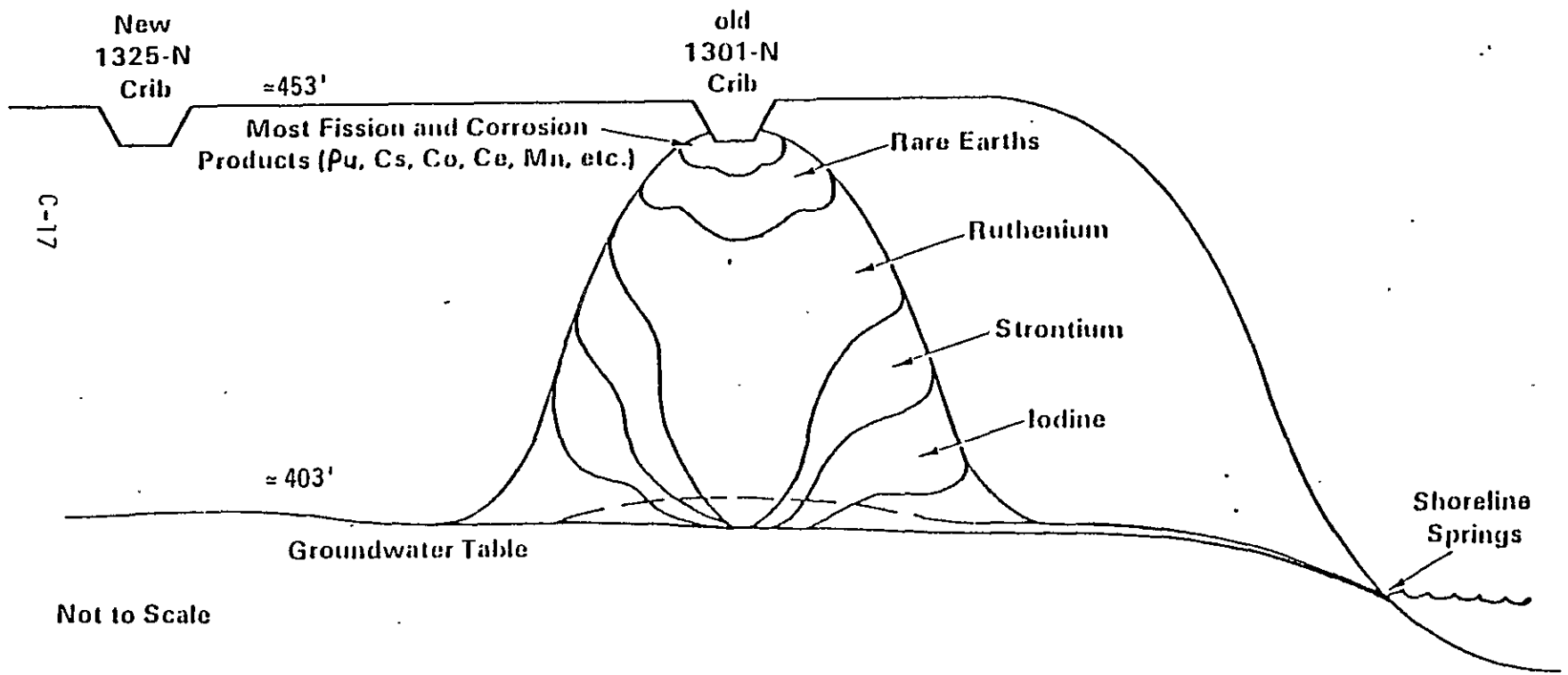


TABLE 2

ANNUAL RELEASE TO 1301-N AND 1325-N LWDFs (CURIES)

RADIONUCLIDE	1964-1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983 *	1984 **
Co-60	NR	200	82	84	230	330	220	320	320	370	640	870	940	770	1,200	370	500	770	1,500
Sr-90	NR	270	270	7.4	7.3	17	21	16	63	93	110	120	120	130	160	84	140	110	310
Ru-106	NR	NR	NR	NR	29	110	63	190	82	110	130	230	330	310	320	100	120	65	130
Cs-134	NR	NR	NR	NR	16	18	4.1	23	39	50	69	83	68	56	55	21	30	14	18
Cs-137	NR	88	41	2.8	51	92	18	46	170	240	320	380	340	290	360	240	270	200	210
Pu-239/240	NR	NR	NR	NR	NR	NR	NR	NR	NR	.37	.55	.67	1.3	1.1	1.4	.56	2.2	2.0	3.9
TOTALS	NR	560	390	94	330	570	330	600	670	860	1,300	1,700	1,800	1,600	2,100	820	1,100	1,200	2,200

NR - Not Reported
* - 22% of total release to 1325-N LWDF
** - 19% of total release to 1325-N LWDF

TABLE 3

CUMULATIVE INVENTORY IN 1301-N AND 1325-N LWDFs (CURIES)**

RADIONUCLIDE	1964-1966*	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Co-60	500	620	620	630	760	980	1,100	1,200	1,400	1,600	2,000	2,500	3,100	3,400	4,100	4,000	4,000	4,200	5,100
Sr-90	580	830	1,100	1,100	1,000	1,000	1,000	1,000	1,100	1,100	1,200	1,300	1,400	1,500	1,600	1,700	1,800	1,800	2,100
Ru-106	130	140	140	140	100	130	110	190	150	160	170	250	360	410	440	300	240	170	180
Cs-134	40	44	48	51	53	54	42	49	68	91	120	160	170	170	170	140	120	100	87
Cs-137	180	260	290	290	330	420	420	460	620	840	1,100	1,500	1,800	2,000	2,300	2,500	2,700	2,900	3,000
Pu-239/240	2.3	3.1	3.9	4.7	5.5	6.2	7.0	7.8	8.6	8.9	9.5	10	11	12	14	14	16	18	22
TOTALS	1,400	1,900	2,200	2,200	2,300	2,600	2,700	2,900	3,400	3,800	4,600	5,700	6,800	7,600	8,700	8,600	8,800	9,200	11,000

* - Extrapolated
** - INVENTORY = ANNUAL RELEASE $(1-e^{-\lambda T})/\lambda$ + INVENTORY$_1$ $(e^{-\lambda T})$; WHERE $\lambda = \frac{\ln 2}{t_{1/2}}$, T = 1 yr., and INVENTORY$_1$ = CUMULATIVE INVENTORY UP TO THE PRECEDING YEAR.

Table 4. Average Concentrations (pCi/g - dry wt.) of Selected Radionuclides in 1301-N Trench Sediment Samples Since 1975.

Year	Co-60	Cs-137	Sr-90	Pu-239/240
1975	5.2×10^{6}	1.1×10^{6}	2.4×10^{3}	9.8×10^{2}
1976	2.0×10^{6}	1.8×10^{5}	2.7×10^{4}	3.7×10^{3}
1977	7.1×10^{5}	7.9×10^{4}	2.1×10^{4}	4.6×10^{3}
1978	5.2×10^{6}	2.2×10^{5}	2.5×10^{4}	5.2×10^{3}
1979	2.6×10^{7}	8.1×10^{5}	4.2×10^{4}	6.2×10^{3}
1980	6.4×10^{6}	2.8×10^{5}	1.1×10^{5}	4.0×10^{4}
1981	9.1×10^{6}	4.5×10^{5}	1.5×10^{5}	1.8×10^{4}
1982	1.5×10^{7}	6.6×10^{5}	1.6×10^{5}	4.2×10^{5}
1983	1.2×10^{7}	6.2×10^{5}	2.8×10^{4}	7.8×10^{3}
1984	2.2×10^{7}	1.2×10^{6}	1.2×10^{5}	2.1×10^{4}
Average (last 10 yrs)	1.0×10^{7}	5.6×10^{5}	6.8×10^{4}	5.3×10^{4}

3.0 CLOSURE AND POST-CLOSURE PLAN ELEMENTS

3.1 Assumptions

The following assumptions were used in developing aspects of the closure plan:

- o 1301-N will require some form of interim stabilization prior to final closure and until operation of 1325-N is discontinued.

- o Interim stabilization will allow for the continued use of the 1301-N facility as necessary. Acceptable operational performance of the 1325-N facility between now and the commencement of 1301-N interim stabilization may change this assumption, allowing the complete isolation of 1301-N from effluent flow.

- o Interim stabilization actions will not prevent any permanent closure options.

- o At the termination of the 1325-N facility operation, permanent closure of both 1301-N and 1325-N will commence unless it is determined that residual contamination levels warrant waiting a certain period for radioactive decay, whereupon 1325-N will also be interim stabilized.

- o The 1301-N and 1325-N facilities should not be subject to hazardous waste regulations. A sampling program will be completed in 1985 that will identify any hazardous non-radioactive constituents in the waste streams. Should hazardous substances be identified, subsequent actions will depend upon an agreement between DOE, WDOE, and EPA on which radioactive waste streams and disposal facilities are subject to control under hazardous waste regulations.

  Note: Because of the past disposal practice of using sodium dichromate in the control rod cooling system and dumping it into the 1301-N facility, crib and trench sediment samples will have to be obtained and analyzed for hazardous waste constituents. The same conditions as in the preceding paragraph would then apply.

- o Institutional control can, if necessary, be maintained on the sites from the time of permanent closure for a period of at least 100 years.

3.2 Considerations

The plan discusses several options. A detailed characterization of the sediment and soil column beneath the 1301-N and 1325-N cribs and trenches may be necessary to formulate permanent closure plans. Radionuclide inventories and spatial distribution should be quantified. The following items may influence the disposition of the subject facilities.

- Should the sludge be identified as TRU waste (>100 nCi/g, see DOE Order 5820.2 for a complete definition) disposition may involve either removal of the sludge for disposal in the 200 Areas or mixing of the sludge into a soil layer to obtain a uniformly lower TRU concentration. Simple placement of a soil overburden would not be adequate. Routine annual sampling of the 1301-N trench sediment (see Table 4) indicates Pu-239/240 concentrations are about 50 nCi/g. For determining total TRU concentration, other contributing transuranic isotopes would have to be included.

- Although DOE is not required to adhere to the requirements of 10 CFR 61, prudent judgment may argue to follow its guidance. Characterization of the mixture of radionuclides present in the soil column or sludge should be compared to the Class C limits of 10 CFR 61 (using sum of the fractions rule).

- The 1301-N crib and trench sediments will have to be analyzed for hazardous waste constituents in accordance with WAC 173-303. If classified as hazardous waste, removal or in-situ disposal requirements will be dependent upon the regulations UNC is required to meet.

- Characterization should determine the extent (spatial distribution) and amount (curies/concentrations) of the contamination. If a protective barrier is deemed necessary due to radionuclide concentration levels, spatial distribution will determine the size and type of such a barrier.

  Note: If the interim stabilization does not interfere with a later detailed characterization program and does not constitute an irreversible action, stabilization may be allowed to proceed before the detailed characterization is completed.

4.0 INTERIM STABILIZATION

4.1 Stabilization

4.1.1 Stabilization of the disposal site is necessary for interim care of approximately 5-20 years. Stabilization of the retired disposal facility shall limit the biotransport of radionuclides and provide shielding from gamma radiation, but not reduce significantly for 1301-N the ability to accept liquid waste on an emergency basis. Additionally, stabilization shall not prevent overflow to the shallow disposal basin in the event of an ECS dump.

At the same time, should routine effluent flow be re-initiated to 1301-N, stabilization shall not cause these flows to enter the shallow disposal basin. Stabilization:

- o Is desirable from the standpoint of allowing radioactive decay before permanent exposure dependent actions are taken.
- o Is necessary over the "do-nothing case" to allow adequate radiological control of the site prior to permanent closure.
- o Will allow time to monitor radionuclide migration before permanent disposition actions are taken.
- o Will reduce personnel exposure.
- o Will reduce surveillance and maintenance costs.

4.1.2 For proper stabilization a protective barrier is needed for the 1301-N crib and weir box area, enabling further isolation of the radioactivity from man and the surface environment. The barrier may consist of:

- o Crushed rock or gravel to cover and fill the voids created by the existing boulders.
- o A synthetic liner may then be applied over the uniform grade. A liner should minimize the amount of soil cover to be treated as contaminated should the material have to be removed during permanent closure.
- o A minimum of two feet of topsoil should be applied next and seeded with locally established grasses. (The depth of topsoil is dependent upon the grass seeded.) The intent is to ensure an adequate amount of evapotranspiration to prevent water from collecting on the liner surface. A rock mulch layer may be added to prevent soil erosion and loss of vegetation.
- o An alternative to the liner-topsoil-grass barrier would be to shotcrete the crushed rock layer with 1-2 inches of concrete.

- o The weir box should be covered with a concrete cover.

Performance requirements for the protective barriers should consider:

- o The weir box cover should not impede effluent flow to the 1325-N facility and still allow for weir overflow into the 1301-N crib (both from an emergency use consideration and due to expected reactor decontamination flush flow rates). Additionally, the cover should also allow overflow to the shallow disposal basin in the event of an ECS dump.

- o The covered crib should still be able to accept waste from the weir box without disturbing the stability of the cover.

- o The crib and weir box cover should be designed to prevent dose rates from exceeding 10 mrem/hr at one meter above the cover surface.

4.1.3 The protective storage for the trench is largely accomplished by the existing concrete panel cover. The addition of approximately two feet of sand onto the bottom of the trench is necessary to contain the radionuclides in the trench sediments and provide shielding for the gamma radiation. Considerations in applying the sand barrier include:

- o Dose rates should be limited as in 4.1.2 above.

- o The two feet of sand can be applied by drilling a few access holes or removing the centermost panels of the concrete cover, then applying a sand and water slurry.

- o The slurry should be pumped or gravity fed into the trench at intervals to assure uniform coverage of the trench bottom.

- o The water used for slurry application should drain, leaving a two foot layer of sand which can still percolate water. For routine effluent flows the presence of the sand should not cause overflow to the shallow disposal basin.

Alternately, a soil cover placed atop the trench cover can be used for stabilization provided the load limit of the trench cover is not exceeded and the soil cover requirements of Section 4.1.2 are met. No liner is required.

4.2 Residual Radionuclide Inventory

Characterization of the residual radionuclide inventories of the 1301-N and 1325-N facilities should consider the following:

- Final closure methods must consider the cumulative effects of the combined 1301-N and 1325-N inventories.
- Final characterization can be performed during the interim stabilization period or as the first step when proceeding to permanent closure without interim stabilization. Continued use of the 1301-N facility may preclude final characterization until the use of the facility is discontinued.
- Sampling will involve surface sediment and soil sampling at different depth intervals and over a surface area sufficient to assess the lateral radionuclide migration above the ground water table. Initial characterization, to be completed by the end of March 1986, will sample and analyze the surface sediments in the 1301-N trench.
- Radionuclides that are analyzed for must include gamma-emitters, all transuranic isotopes and, as a minimum, those radionuclides identified in Tables 1 and 2 of 10 CFR 61. Total inventories of H-3, Tc-99, C-14, and I-129 should be determined (10 CFR 61 requirement, but here applied as guidance). Total alpha can be used to quantify the amount of transuranic isotopes present.
- Source-term data (crib influent) should also be used to estimate radionuclide inventories (see Tables 2 and 3).
- Effects of radionuclide decay should be projected to the estimated times of final closure and 100 years following final closure.
- Sampling and characterization data must be statistically valid to a desired confidence level.

4.3 Security

Security systems established to prevent unauthorized entry or removal of equipment during interim closure shall include the following considerations:

- Access restrictions shall be maintained using security fencing or other physical barriers. The existing security fence with entry gates and radiation zone signs should be adequate.
- Hanford Patrol will continue to monitor the site on a routine schedule.

- Surveillance monitoring shall continue with routine patrols by N Plant Operations checking for signs of intrusions by man and animal.

4.4 Emergency Response

Maintenance of emergency response plans, facilities, and equipment until final closure is complete shall be accomplished with the following considerations:

- Emergency notification lists shall be maintained by the Environmental and Emergency Preparedness Section in case of unauthorized human intrusion or adverse radiological conditions. UNI-M-31 and UNI-M-2 shall provide updated call lists for reference.

- Sampling and measurement procedures shall be provided in UNI-M-76 and the Radiation Work Procedures in UNI-M-33. Trained personnel shall be used to assure radiological health and safety practices are met.

- The 100-N ECC will be operational during the interim closure period. Emergency sampling and monitoring equipment shall be maintained in the ECC (Emergency Control Center).

- If a vegetation cover is added, proper fire control measures shall be put in place; i.e. having a source of water available for grass fires.

4.5 Surveillance and Maintenance

Maintenance of a periodic surveillance and maintenance program until closure is complete shall be accomplished with the following considerations:

- Routine radiological sampling and monitoring shall be conducted with the procedures and methods provided in UNI-M-76 (updated to reflect the 1325-N facility).

- Routine visual inspections of the facility for needed repairs, subsidence in backfill cover, deep-rooted plants, burrowing animals, ant colonies, etc., shall be made by N Plant Operations. Radioactive Effluent Control will also perform periodic visual inspections and appraisals. UNI-M-31 shall contain the surveillance requirements.

- Routine ground water monitoring shall be performed for the facility on a quarterly basis. Radionuclide concentrations shall be measured and recorded in trend files of the Environmental Release Summary (ERS) computer system. Routine effluent sampling shall continue to provide monitoring of the N-Springs.

- Routine soil and vegetation sampling shall be performed in the vicinity of the two waste disposal facilities on an annual basis. Radionucide concentrations shall be measured and recorded in trend files of the ERS.

- A routine TLD dosimetry surveillance program shall be maintained continuously and measured every four weeks. Dose rates shall be measured and recorded in trend files. As trends indicate no adverse conditions, the number of sampling stations can be reduced accordingly.

- Routine dose rate monitoring with portable instruments shall be performed annually to provide a comprehensive mapping of localized dose rates.

- Sediment sampling from the bottom of the disposal trenches (and crib for 1325-N) shall be performed annually until interim stabilization of 1301-N or 1325-N prohibits normal sampling techniques or until final characterization is complete.

- The periodic surveillances described above shall be reported annually in UNC's Environmental Surveillance Report. The routine surveillance program will be expanded for operation of the new 1325-N trench, which was placed into operation in September 1985.

- Sampling and monitoring frequencies and locations will be varied as performance dictates (stabilization performance for 1301-N; operational performance for 1325-N). Figures 7 through 12 show the current sampling and monitoring locations for the various routines described above (not currently updated to account for the 1325-N trench).

- During interim closure, potential biotransport pathways will be assessed to aid in refining the permanent closure requirements.

5.0 PERMANENT CLOSURE

5.1 Residual Radionuclide Inventory

The following items should be considered when developing final closure plans.

- The radionuclide characterization data performed, as described in Section 4.2, will determine the method of final closure.

  Note: As discussed previously, hazardous waste implications may also have an impact.

- Allowable Residual Contamination Level (ARCL) calculations will determine dose rates via pathway analysis. The methodology is described in UNI-2522. The need for a biobarrier is dependent upon these calculations (need for dose reduction) and the potential for contamination being brought to the surface via biotic transport mechanisms.

Figure 7
Locations of Groundwater Wells at 100-N Area

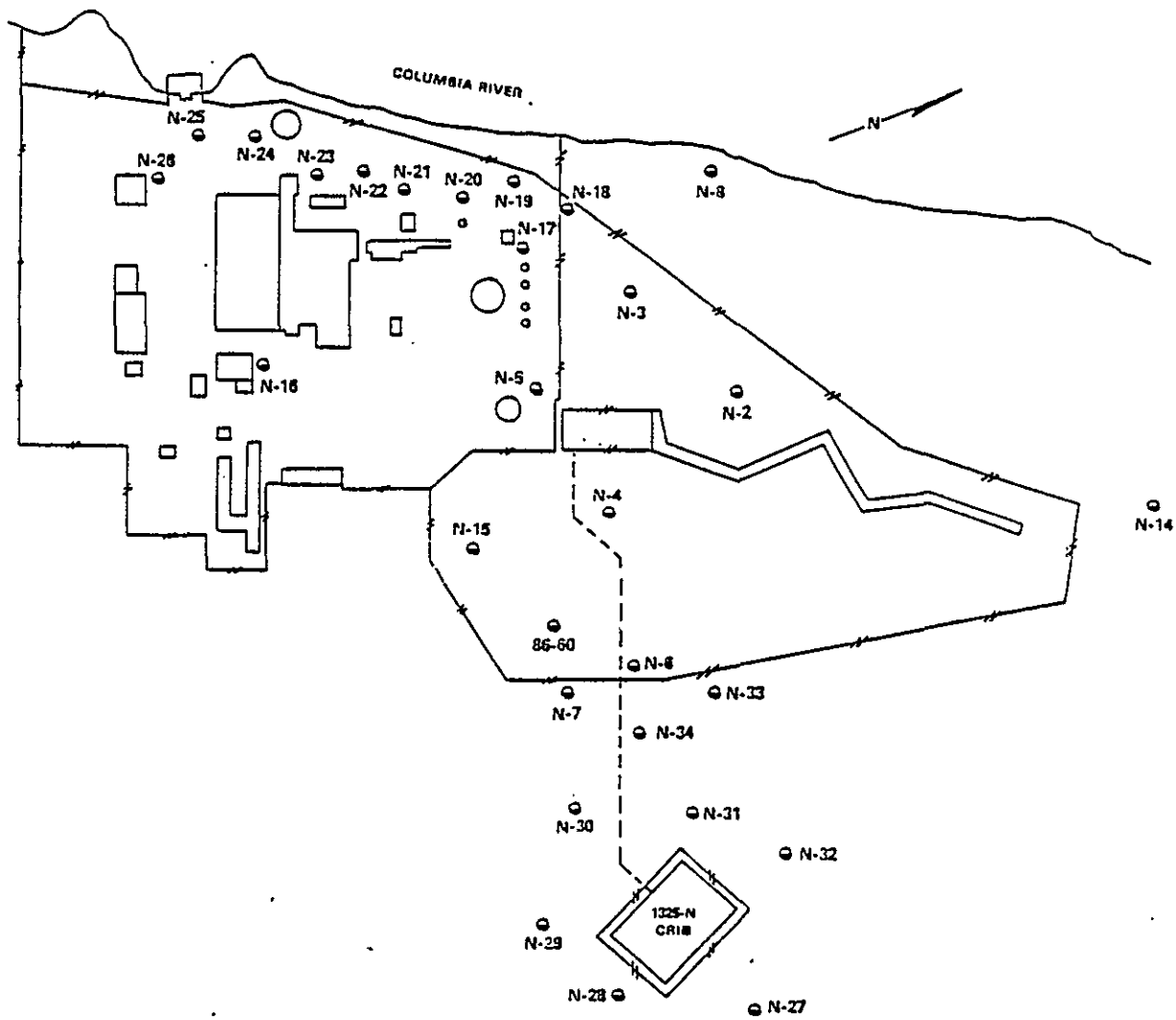


Figure 8

Vegetation and Soil Sampling Sites at 100-N Area

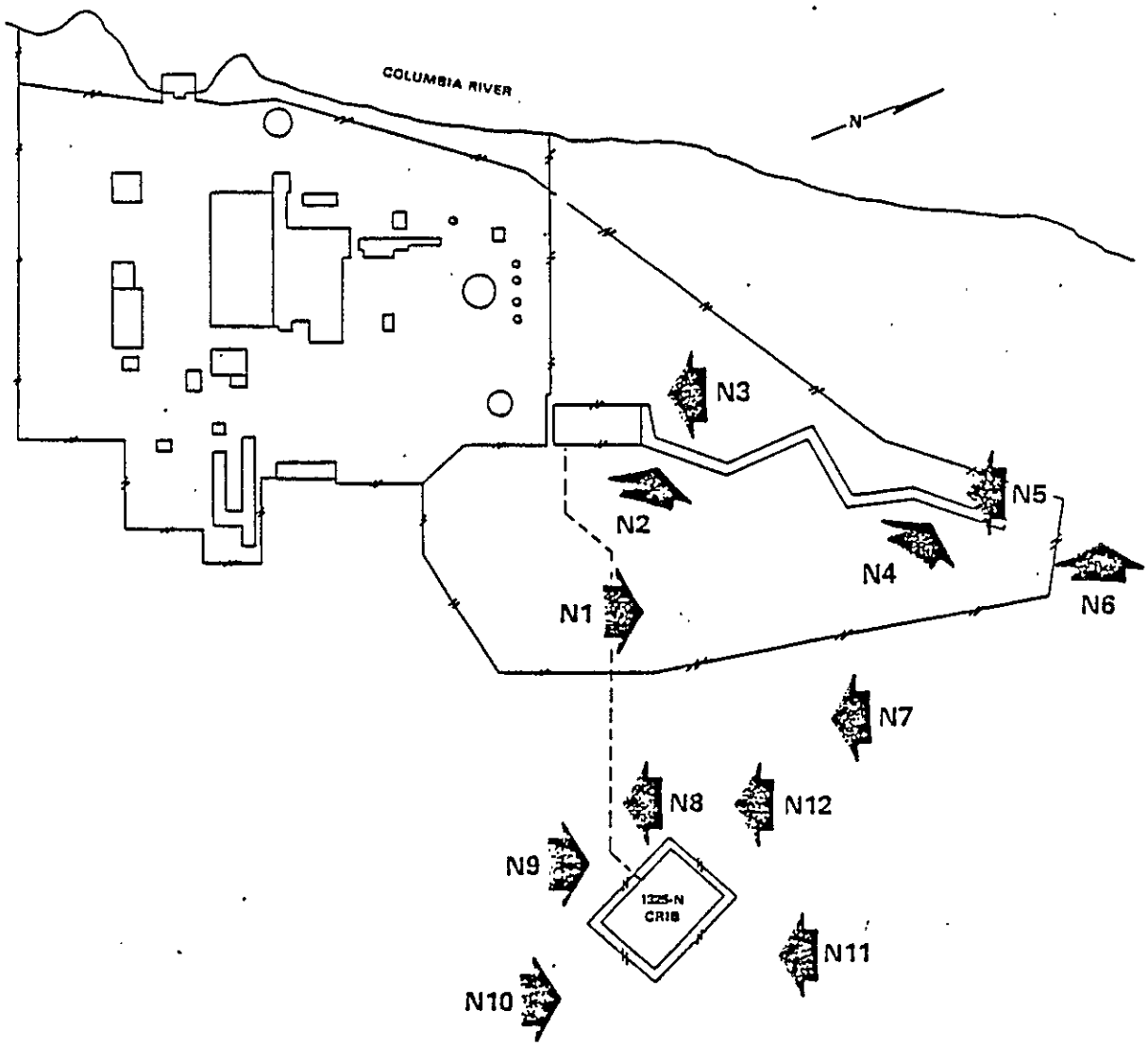


Figure 9

1301-N Trench Sediment Sampling Locations

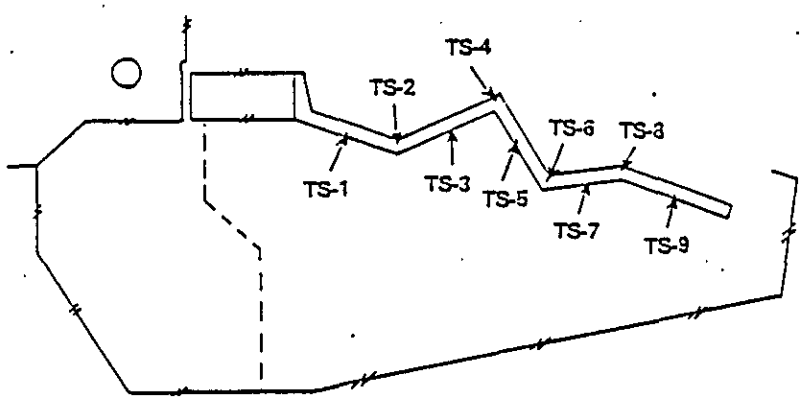


Figure 10

Grid Used for Radiation Survey Around the 1301-N Facility

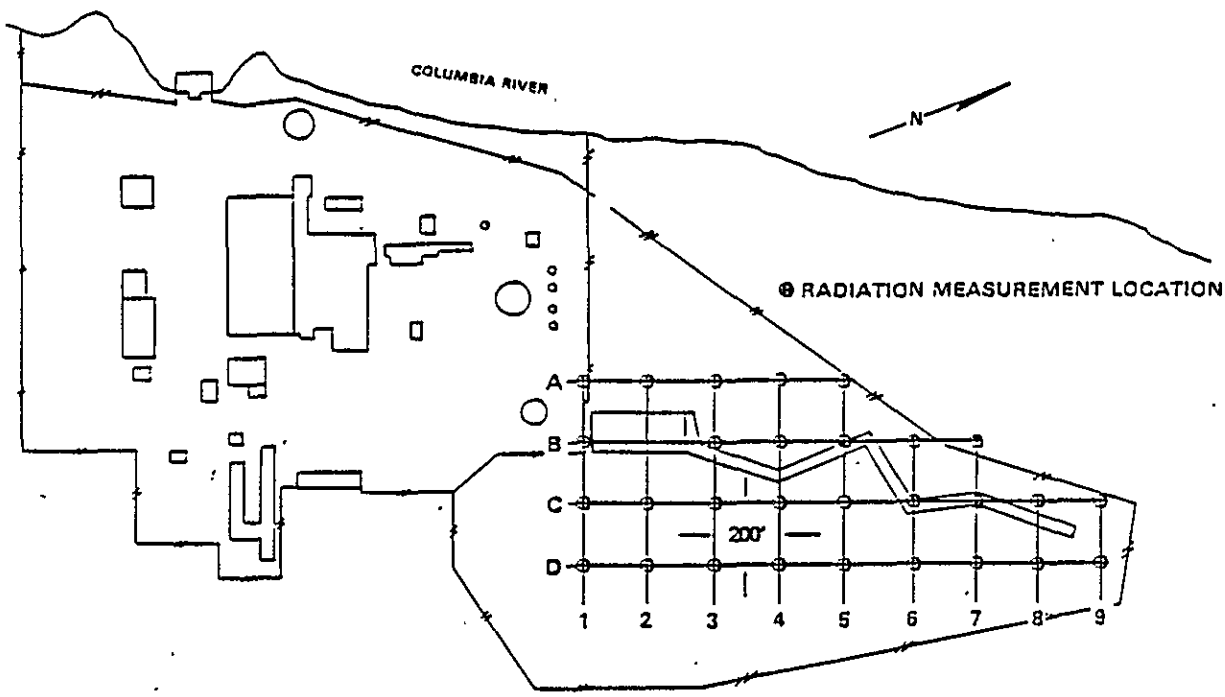


Figure 11
Locations of Environmental Dosimeters and Shoreline Survey

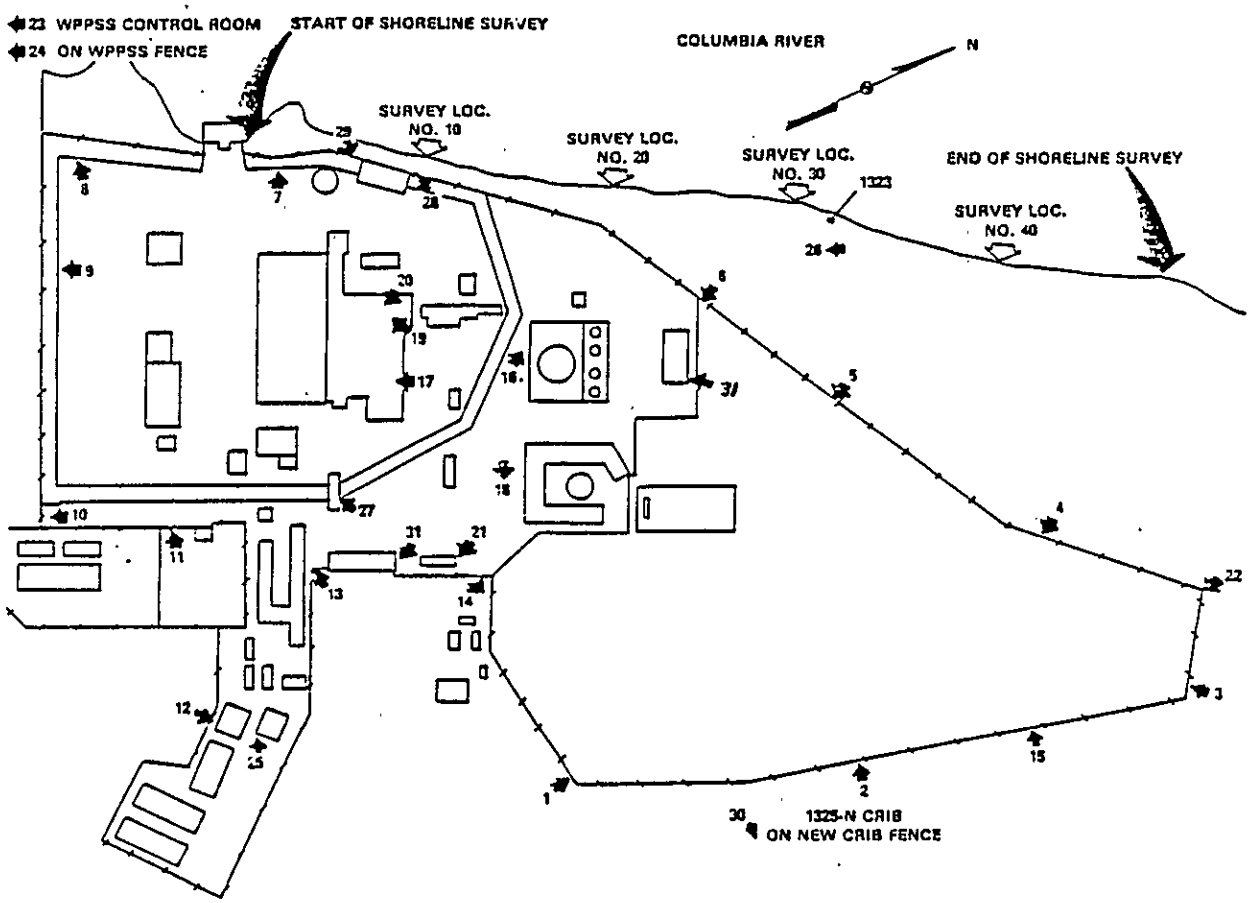
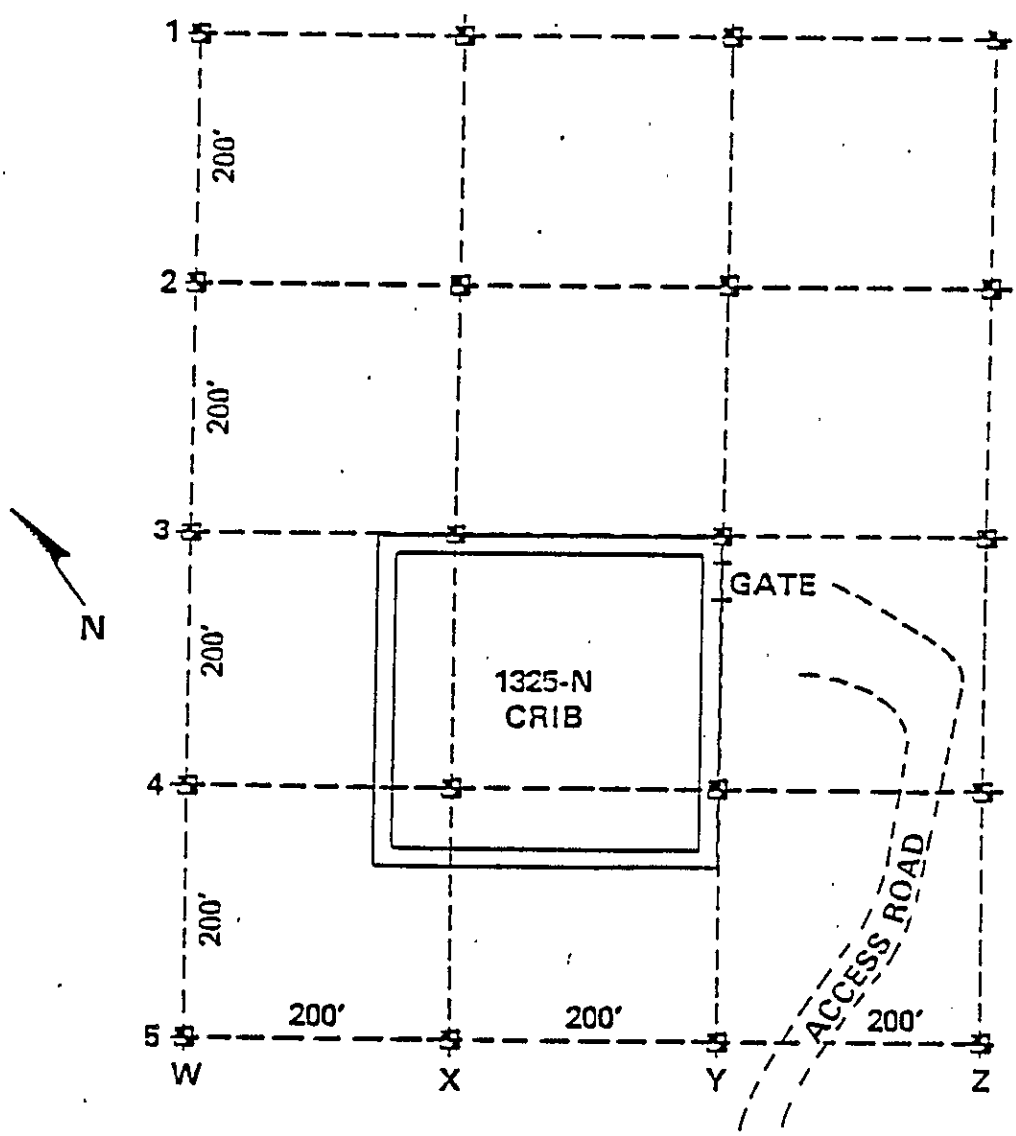


Figure 12

Grid Used for Radiation Survey Around 1325-N Facility



- o ARCL calculations may dictate the need for a certain depth of fill in addition to a barrier to meet the dose requirements. Based on current guidance, dose to the maximum individual shall not exceed 25 mrem/yr to the whole body or to any organ at the time of unrestricted release (following institutional control). Occupational exposure to individuals performing the actual closure operations and subsequent surveillance and maintenance shall also be minimized.

5.2 Permanent Disposition Cases

For 1301-N, the limited characterization to be completed by the end of March 1986 on the 1301-N trench surface sediments should allow determination of the appropriate permanent closure case.

5.2.1 Case I - Removal of crib and trench sediment is required.

- o Remove backfill and liner or shotcrete (if previously placed during interim stabilization) and concrete trench covers as appropriate.
- o Remove crushed rock, cobbles, sand and bottom sediment and dispose of in the 200 Area burial grounds.
- o Remaining soil column contaminated material not meeting ARCL or TRU limits shall also be removed and disposed of in the 200 Area burial grounds.

5.2.1 Case II - Removal of crib and trench sediment is not required.

- o Using slurry (sand, grout) fill under the 1325-N crib cover and 1301-N and 1325-N trench covers; seal trench and crib covers with grout. An alternative method may be chosen for permanent isolation as dictated by future regulations and technology.
- o Extend biobarrier margins as necessary to effectively isolate areas of radionuclide migration (dependent upon concentration levels) with roller compacted concrete, rock barrier, or other appropriate biobarrier. Roller compacted concrete, a rock barrier, or other biobarrier, may need to be added to the boulder layer in the 1301-N crib. Specific biobarrier engineering may require technical study to determine the best alternative. The presence of Class C waste may require the barrier to maintain its integrity for 500 years (10 CFR 61 requirement to be used as guidance).
- o Cover biobarrier with a minimum of 2 feet of fertile soil and proceed as in Section 4.1.2 for surface stabilization (do not place liner). ARCL dose calculations may warrant increasing the depth of this soil layer.

- All 1301-N and 1325-N facility inlet piping shall either be removed or stabilized in place as determined by the characterization data. Stabilization in place shall consist of backfilling the pipes with slurry and sealing the pipe ends to limit radionuclide migration due to a future loss of pipe integrity.

5.3 Permanent Identification Markers and Monitoring Wells

Permanent identification markers for the disposal site and monitoring wells shall be provided as follows:

- Once the extent of the contaminated disposal site surface area has been determined, install permanent concrete markers around the margins of the site, in accordance with Hanford Standard AC-5-40 Rev 7 for identifying underground radioactive contamination. Ensure markers delineate a buffer zone of at least 50 feet from any potential subsurface contamination. Permanent markers are necessary until the radionuclide inventory has decayed below unrestricted release levels.

- Install additional monitoring wells outside the permanent markers, if necessary.

5.4 Post-Closure Care

- For a period of at least 10 years following closure, perform active maintenance on the disposal site to ensure site will remain stabilized for the entire institutional control period of 100 years and thereafter until such time as the radionuclide concentration levels decay to unrestricted release levels.

- For Class C waste, the installed intrusion barrier should maintain its integrity for a period of 500 years (10 CFR 61). Access control shall be maintained during the institutional control period, as necessary.

- Unneeded equipment shall be removed from the facilities.

- The maintenance and surveillance program of Section 4.5 shall be performed during the institutional control period, as necessary.

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APPENDIX D

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APPENDIX E

LIST OF DANGEROUS WASTE CONSTITUENTS IN WAC 173-303-9905

APPENDIX E
LIST OF DANGEROUS WASTE CONSTITUENTS IN WAC 173-303-9905

This appendix identifies the approach to be taken to analyze for the list of dangerous waste constituents contained in WAC 173-303-9905. U. S. Testing Company, Inc. will conduct analyses for those constituents on the list for which methodology is currently available.

Table E.1 contains a numbered list of all of the WAC 173-303-9905 constituents, the specific method to be used for analysis, and reference to one of several other tables (E.2 through E.10) which associates each constituent with an analytical category. Where available, SW-846 (USEPA, July 1982 "Test Methods for Evaluating Solid Waste) methods will be used. Where SW-846 does not provide sufficient information to analyze for a particular constituent, another standard method is listed. Two categories of compounds will not be analyzed directly:

1. constituents unstable in water
2. constituents for which no analytical method is available.

The following approach will be taken when analyzing for volatile and semivolatile constituents (Tables E.2 and E.3). A quantitative analysis will be performed by GC/MS on those compounds from these lists which are also on the Priority Pollutant list (40 CFR Part 122). All other 9905 compounds will be searched for by NBS Library computer search of all peaks in the chromatogram of the sample which are greater than 20% of the nearest internal standard. Quantitation of the tentatively identified peak will be against the nearest internal standard, and the response factor will be assumed to be 1. Rigorous quantitation of tentatively identified compounds will be performed upon request, and the analyses are subject to the availability of standards.

Chain-of-custody and general quality control procedures will be those detailed in the "Methods" section of the plan. For additional quality control procedures specific to individual methods, see the methods referenced in Table E.1.

TABLE E.1 DANGEROUS WASTE CONSTITUENTS LIST

	Constituent	Method[a]	Table
1	Acetonitrile	SW-846, 8270	E.3
2	Acetophenone	SW-846, 8270	E.3
3	Warfarin	SW-846, 8270	E.3
4	2-Acetylaminofluorene	SW-846, 8270	E.3
5	Acetyl chloride	Unstable	E.8
6	1-Acetyl-2-thiourea	SW-846, 8330	E.10
7	Acrolein	SW-846, 8240	E.2
8	Acrylamide	GC/MS, Dir. Inj.	E.4
9	Acrylonitrile	SW-846, 8240	E.2
10	Aflatoxins	Exotic	E.9
11	Aldrin	SW-846, 8080	E.6
12	Allyl alcohol	GC/MS, Dir. Inj.	E.4
13	Aluminum phosphide	Unstable	E.8
14	4-Aminobiphenyl	SW-846, 8270	E.3
15	Mitomycin C	Exotic	E.9
16	5-(Aminomethyl)-3-isoxazolol	SW-846, 8270	E.3
17	Amitrole	SW-846, 8270	E.3
18	Aniline	SW-846, 8270	E.3
19	Antimony and compounds	SW-846, 6010	E.5
20	Aramite	SW-846, 8270	E.3
21	Arsenic and compounds	SW-846, 7060	E.5
22	Arsenic acid	SW-846, 7060	E.5
23	Arsenic pentoxide	SW-846, 7060	E.5
24	Arsenic trioxide	SW-846, 7060	E.5
25	Auramine	SW-846, 8270	E.3
26	Azaserine	Exotic	E.9
27	Barium and compounds	SW-846, 6010	E.5
28	Barium cyanide	SW-846, 6010	E.5
29	Benz(c)acridine	SW-846, 8270	E.3
30	Benz(a)anthracene	SW-846, 8270	E.3
31	Benzene	SW-846, 8240	E.2
32	Benzenearsonic acid	SW-846, 7060	E.5
33	Benzene, dichloromethyl	SW-846, 8270	E.3

TABLE E.1 DANGEROUS WASTE CONSTITUENTS LIST (contd.)

	Constituent	Method[a]	Table
34	Benzenethoil	SW-846, 8270	E.3
35	Benzidine	SW-846, 8270	E.3
36	Benzo(b)fluoranthene	SW-846, 8270	E.3
37	Benzo(j)fluoranthene	SW-846, 8270	E.3
38	Benzo(a)pyrene	SW-846, 8270	E.3
39	p Benzoquinone	SW-846, 8270	E.3
40	Benzotrichloride	Unstable	E.8
41	Benzyl chloride	SW-846, 8720	E.3
42	Beryllium and compounds	SW-846, 6010	E.5
43	Bis(2-chloroethoxy)methane	SW-846, 8270	E.3
44	Bis(2-chloroethyl)ether	SW-846, 8270	E.3
45	Chlornaphazine	SW-846, 8270	E.3
46	Bis(2-chloroisopropyl)ether	SW-846, 8270	E.3
47	Bis(chloromethyl)ether	SW-846, 8240	E.2
48	Bis(2-ethylhexyl)phthalate	SW-846, 8270	E.3
49	Bromoacetone	SW-846, 8240	E.2
50	Methyl bromide	SW-846, 8240	E.2
51	4-Bromophenyl phenyl ether	SW-846, 8270	E.3
52	Brucine	Exotic	E.9
53	2-Butanone peroxide	Unstable	E.8
54	Butyl benzyl phthalate	SW-846, 8270	E.3
55	2-sec-butyl-4,6-dinitrophenol	SW-846, 8270	E.3
56	Cadmium and compounds	SW-846, 6010	E.5
57	Calcium chromate	SW-846, 6010	E.5
58	Calcium cyanide	SW-846, 9010	E.10
59	Carbon disolfide	SW-846, 8240	E.2
60	Carbon oxyfluoride	Unstable	E.8
61	Chloral	HC/MS, Dir. Inj.	E.4
62	Chlorambucil	Exotic	E.9
63	Chlordane	SW-846, 8080	E.6
64	Chlorinated benzenes	SW-846, 8270	E.3
65	Chlorinated ethane	SW-846, 9020	E.7
66	Chlorinated fluorocarbons	SW-846, 9020	E.7

TABLE E.1 DANGEROUS WASTE CONSTITUENTS LIST (contd.)

	Constituent	Method[a]	Table
67	Chlorinated napthalene	SW-846, 9020	E.7
68	Chlorinated phenol	SW-846, 9020	E.7
69	Chloroacetaldehyde	GC/MS, Dir. Inj.	E.4
70	Chloroalkyl ethers	SW-846, 8270	E.3
71	P-Choroaniline	SW-846, 8270	E.3
72	Chlorobenzene	SW-846, 8240	E.2
73	Chlorobenzilate	AOAC - 6.431	E.6
74	p-Chloro-m-cresol	SW-846, 8270	E.3
75	1-Chloro-2,3-epoxypropane	SW-846, 8270	E.3
76	2-Chloroethyl vinyl ether	SW-846, 8240	E.2
77	Chloroform	SW-846, 8240	E.2
78	Methyl chloride	SW-846, 8240	E.2
79	Chloromethyl methyl ether	SW-846, 8240	E.2
80	2-Chloronaphthalene	SW-846, 8270	E.3
81	1-Chlorophenol	SW-846, 8270	E.3
82	1-(o-Chlorophenyl)thiourea	SW-846, 8330	E.10
83	3-Chloropropionitrile	GC/MS, Dir. Inj.	E.4
84	Chromium and compounds	SW-846, 6010	E.5
85	Chrysene	SW-846, 8270	E.3
86	Citrus red No. 2	AOAC-34.015B	E.10
87	Coal tars	SM-505	E.7
88	Copper cyanide	SW-846, 6010	E.5
89	Creosote	SM-505	E.7
90	Cresols	SW-846, 8270	E.3
91	Crotonaldehyde	SW-846, 8240	E.2
92	Cyanides	SW-846, 9010	E.10
93	Cyanogen	GC/MS, Dir. Inj.	E.4
94	Cyanogen bromide	AOAC-34.015 B	E.10
95	Cyanogen chloride	AOAC-34.015 B	E.10
96	Cycasin	Exotic	E.9
97	2-Cyclohexyl-4.6-dinitrophenol	SW-846, 8270	E.3
98	Cyclophosphamide	Exotic	E.9
99	Daunomycin	Exotic	E.9

TABLE E.1 DANGEROUS WASTE CONSTITUENTS LIST (contd.)

	Constituent	Method[a]	Table
100	DDD	SW-846, 8080	E.6
101	DDE	SW-846, 8080	E.6
102	DDT	SW-846, 8080	E.6
103	Diallate	Exotic	E.9
104	Dibenz(a,h)acridine	SW-846, 8270	E.3
105	Dibenz(a,j)acridine	SW-846, 8270	E.3
106	Dibenz(a,h)anthracene	SW-846, 8270	E.3
107	7H-Dibenzo(c,g)carbazole	SW-846, 8270	E.3
108	Dibenzo(a,e)pyrene	SW-846, 8270	E.3
109	Debenzo(a,h)pyrene	SW-846, 8270	E.3
110	Debenzo(a,i)pyrene	SW-846, 8270	E.3
111	1,2-Dibromo-3-chloropropane	SW-846, 8240	E.2
112	1,2-Dibromoethane	SW-846, 8240	E.2
113	Dibromomethane	SW-846, 8240	E.2
114	Di-n-butyl phthalate	SW-846, 8270	E.3
115	Benzene, 1,2-dichloro	SW-846, 8270	E.3
116	Benzene, 1,3-dichloro	SW-846, 8270	E.3
117	Benzene, 1,4-dichloro	SW-846, 8270	E.3
118	Dichlorobenzene	SW-846, 9020	E.7
119	3,3'-Dichlorobenzidine	SW-846, 8270	E.3
120	1,4-Dichloro-2-butene	SW-846, 8240	E.2
121	Dichlorodifluoromethane	SW-846, 8240	E.2
122	1,1-Dichloroethane	SW-846, 8240	E.2
123	1,2-Dichloroethane	SW-846, 8240	E.2
124	tran-1,2-Dichloroethene	SW-846, 8240	E.2
125	Dichloroethylene	SW-846, 9020	E.7
126	1,1-Dichloroethylene	SW-846, 8240	E.2
127	Methylene chloride	SW-846, 8240	E.2
128	2,4-Dichlorophenol	SW-846, 8270	E.3
129	2,6-Dichlorophenol	SW-846, 8270	E.3
130	2,4-D	SW-846, 8150	E.6
131	Dichlorophenylarsine	SW-846, 7060	E.5
132	Dichloropropane	SW-846, 9020	E.7

TABLE E.1 DANGEROUS WASTE CONSTITUENTS LIST (contd.)

	Constituent	Method[a]	Table
133	1,2-Dichloropropane	SW-846, 8240	E.2
134	Dichloropropanol	GC/MS, Dir. Inj.	E.4
135	Dichloropropene	SW-846, 9020	E.7
136	1,3-Dichloropropene	SW-846, 8240	E.2
137	Dieldrin	SW-846, 8080	E.6
138	1,2:3,4-Diepoxybutane	Unstable	E.8
139	Diethylarsine	SW-846, 7060	E.5
140	N,N-Diethylhydrazine	SW-846, 8240	E.2
141	Carbophenothion	AOAC - 29.039	E.6
142	O,O-Diethylphosphoric acid, O-p-nitrophenyl ester	Exotic	E.9
143	Diethyl phthalate	SW-846, 8270	E.3
144	Thionazin	Exotic	E.9
145	Diethylstilbesterol	SW-846, 8330	E.10
146	Dihydrosafrole	SW-846, 8270	E.3
147	3,4-Dihydroxy-alpha-(methylamino) methyl benzyl alchol	Exotic	E.9
148	Diisopropylfluorophosphate	Unstable	E.8
149	Dimethoate	SW-846, 8140	E.9
150	3,3'-Dimethoxybenzidine	SW-846, 8270	E.3
151	p-Dimethylaminoazobenzene	SW-846, 8270	E.3
152	7,12-Dimethylbenz(a)anthracene	SW-846, 8270	E.3
153	3,3'Dimethylbenzidine	SW-846, 8270	E.3
154	Dimethylcarbamoyl chloride	Unstable	E.8
155	1,1-Dimethylhydrazine	SW-846, 8240	E.2
156	1,2-Dimethylhydrazine	SW-846, 8240	E.2
157	Thiofanox	SW-846, 8270	E.3
158	alpha,alpha-Dimethylphenethylamine	SW-846, 8270	E.3
159	2,4-Dimethylphenol	SW-846, 8270	E.3
160	Dimethyl phthalate	SW-846, 8270	E.3
161	Dimethyl sulfate	Unstable	E.8
162	Dinitrobenzene	SW-846, 8270	E.3
163	4,6-Dinitro-o-cresol and salts	SW-846, 8270	E.3

TABLE E.1 DANGEROUS WASTE CONSTITUENTS LIST (contd.)

	Constituent	Method[a]	Table
164	2,4-Dinitrophenol	SW-846, 8270	E.3
165	2,4-Dinitrotoluene	SW-846, 8270	E.3
166	2,6-Dinitrotoluene	SW-846, 8270	E.3
167	Di-n-octyl phthalate	SW-846, 8270	E.3
168	1,4-Dioxane	SW-846, 8240	E.2
169	Diphenylamine	SW-846, 8270	E.3
170	1,2-Diphenylhydrazine	SW-846, 8270	E.3
171	Di-n-propylnitrosamine	SW-846, 8270	E.3
172	Disulfoton	SW-846, 8140	E.6
173	2,4-Dithiobiuret	Exotic	E.9
174	Endosulfan	SW-846, 8080	E.6
175	Endosulfan	SW-846, 8080	E.6
176	Ethyl carbamate	GC/MS, Dir. Inj.	E.4
177	Ethyl cyanide	GC/MS, Dir. Inj.	E.4
178	Ethylenebisdithiocarbamic acid	Exotic	E.9
179	Ethyleneimine	SW-846, 8270	E.3
180	Ethylene oxide	GC/MS, Dir. Inj.	E.4
181	Ethylenethiorea	SW-846, 8330	E.10
182	Ethylmethacrylate	GC/MS, Dir. Inj.	E.4
183	Ethyl methanesulfonate	SW-846, 8270	E.3
184	Fluoranthene	SW-846, 8270	E.3
185	Fluorine	Unstable	E.8
186	2-Fluoroacetamide	Exotic	E.9
187	Fluoroacetic acid	GC/MS, Dir. Inj.	E.4
188	Formaldehyde	Ion Chrom. (In-house)	E.10
189	Formic acid	Ion Chrom. (In-house)	E.10
190	Glycidylaldehyde	GC/MS, Dir. Inj.	E.4
191	Halomethane	SW-846, 9020	E.7
192	Heptachlor	SW-846, 8080	E.6
193	Heptachlor epoxide	SW-846, 8080	E.6
194	Hexachlorobenzene	SW-846, 8270	E.3
195	Hexachlorobutadiene	SW-846, 8270	E.3
196	Lindane and isomers	SW-846, 8080	E.6

TABLE E.1 DANGEROUS WASTE CONSTITUENTS LIST (contd.)

	Constituent	Method[a]	Table
197	Hexachlorocylopentadiene	SW-846, 8270	E.3
198	Hexachloroethane	SW-846, 8270	E.3
199	Hexachlorohexahydro-endo,endo-dimethanonaphthalene	Exotic	E.9
200	Hexachlorophene	SW-846, 8270	E.3
201	Hexachloropropene	SW-846, 8270	E.3
202	Hexaethyl tetraphosphate	Exotic	E.9
203	Hydrazine	SW-846, 8270	E.3
204	Hydrocyanic acid	SW-846, 9010	E.10
205	Hydrofluoric acid	Unstable	E.8
206	Hydrogen sulfide	SW-846, 8240	E.2
207	Hydroxydimethylarsine oxide	SW-846, 7060	E.5
208	Indeno(1,2,3-cd)pyrene	SW-846, 8270	E.3
209	Iodomethane	SW-846, 8240	E.2
210	Iron Dextran	Exotic	E.9
211	Methyl isocyanate	Unstable	E.8
212	Isobutyl alcohol	GC/MS, Dir. Inj.	E.4
213	Isosafrole	SW-846, 8270	E.3
214	Kepone	SW-846, 8080	E.6
215	Lasiocarpine	Exotic	E.9
216	Lead and compounds	SW-846, 6010	E.5
217	Lead acetate	SW-846, 6010	E.5
218	Lead phosphate	SW-846, 6010	E.5
219	Lead subacetate	SW-846, 6010	E.5
220	Maleic anhydride	Unstable	E.8
221	Maleic hydrazide	AOAC-29.129	E.10
222	Malonoitrile	SW-846, 8270	E.3
223	Melphalan	SW-846, 8270	E.3
224	Mercury Fulminate	SW-846, 7470	E.5
225	Mercury and compounds	SW-846, 7470	E.5
226	Methacrylonitrile	SW-846, 8240	E.2
227	Methanethiol	SW-846, 8240	E.2
228	Methapyrilene	SW-846, 8270	E.3

TABLE E.1 DANGEROUS WASTE CONSTITUENTS LIST (contd.)

	Constituent	Method[a]	Table
229	Metholonyl	SW-846, 8270	E.3
230	Methoxychlor	SW-846, 8080	E.6
231	2-Methylaziridine	SW-846, 8270	E.3
232	3-Methylcholanthrene	SW-846, 8270	E.3
233	Methyl chlorocarbonate	Unstable	E.8
234	4,4'-Methylenebis	SW-846, 8270	E.3
235	Methyl ethyl ketone	SW-846, 8240	E.2
236	Methyl hydrazine	GC/MS, Dir. Inj.	E.4
237	2-Methyllactonitrile	SW-846, 8270	E.3
238	Methyl methacrylate	SW-846, 8270	E.3
239	Methyl methanesulfonate	SW-846, 8270	E.3
240	2-Methyl-2-(methylthio) propionaldehyde-o-(methylcarbonyl) oxime	SW-846, 8270	E.3
241	N-Methyl-N'-nitro-N-nitrosoguanidine	Exotic	E.9
242	Methyl parathion	SW-846, 8140	E.6
243	Methylthiouracil	SW-846, 8270	E.3
244	Mustard gas	Exotic	E.9
245	Naphthalene	SW-846, 8270	E.3
246	1,4-Haphthoquinone	SW-846, 8270	E.3
247	1-Naphthylamine	SW-846, 8270	E.3
248	2-Naphthylamine	SW-846, 8270	E.3
249	1-Naphthyl-2-thiourea	SW-846, 8330	E.10
250	Nickel and compounds	SW-846, 6010	E.5
251	Nickel carbonyl	SW-846, 6010	E.5
252	Nickel cyanide	SW-846, 6010	E.5
253	Nicotine and salts	AOAC - 43.444	E.10
254	Nitric oxide	Exotic	E.9
255	p-Nitroaniline	SW-846, 8270	E.3
256	Nitrobenzine	SW-846, 8270	E.3
257	Nitrogen dioxide	Unstable	E.8
258	Nitrogen mustard and hydrochloride salt	Exotic	E.9

TABLE E.1 DANGEROUS WASTE CONSTITUENTS LIST (contd.)

	Constituent	Method[a]	Table
259	Nitrogen mustard N-Oxide and hydrochloride salt	Exotic	E.9
260	Nitroglycerine	Exotic	E.9
261	4-Nitrophenol	SW-846, 8270	E.3
262	4-Nitroquinoline-1-oxide	Exotic	E.9
263	Nitrosamine	SM-417	E.7
264	N-Nitrosodi-n-butylamine	SW-846, 8270	E.3
265	N-Nitrosodiethanolamine	SW-846, 8270	E.3
266	N-Nitrosodiethylamine	SW-846, 8270	E.3
267	N-Nitrosodimethylamine	SW-846, 8270	E.3
268	N-Nitroso-N-ethylurea	SW-846, 8330	E.3
269	N-Nitrosomethylethylamine	SW-846, 8270	E.3
270	N-Nitroso-N-methylurea	SW-846, 8330	E.10
271	N-Nitroso-N-methylurethane	SW-846, 8270	E.3
272	N-Nitrosomethylvinylamine	SW-846, 8270	E.3
273	N-Nitrosomorpholine	SW-846, 8270	E.3
274	N-Nitrosonornicotine	SW-846, 8270	E.3
275	N-Nitrosopiperidine	SW-846, 8270	E.3
276	Nitrosopyrrolidine	SW-846, 8270	E.3
277	N-Nitrososacrosine	Exotic	E.9
278	5-Nitro-o-toluidine	SW-846, 8270	E.3
279	Octamethylpyprophosphoramide	Exotic	E.9
280	Osmium tetroxide	SW-846, 6010	E.5
281	Endothol	Exotic	E.9
282	Paraldehyde	Exotic	E.9
283	Parathion	SW-846, 8140	E.6
284	Pentachlorobenzene	SW-846, 8270	E.3
285	Pentachloroethane	SW-846, 8240	E.2
286	Pentachloronitrobenzene	SW-846, 8270	E.3
287	Pentachlorophenol	SW-846, 8270	E.3
288	Phenacetin	SW-846, 8270	E.3
289	Phenol	SW-846, 8270	E.3
290	Phenylenediamine	SW-846, 8270	E.3

TABLE E.1 DANGEROUS WASTE CONSTITUENTS LIST (contd.)

	Constituent	Method[a]	Table
291	Phenylmercury acetate	SW-846, 7470	E.5
292	N-Phenylthiuourea	SW-846, 8330	E.10
293	Phosgene	Unstable	E.8
294	Phosphine	Exotic	E.9
295	Phorate	Unstable	E.8
296	Famphur	Unstable	E.8
297	Phthalic acid esters	SW-846, 8270	E.3
298	Phthalic anhydride	Unstable	E.8
299	2-Picoline	SW-846, 8270	E.3
300	Polychlorinated biphenyl	SW-846, 8080	E.6
301	Potassium cyanide	SW-846, 9010	E.10
302	Potassium silver cyanide	SW-846, 6010	E.5
303	Pronamide	SW-846, 8270	E.3
304	1,3-Propanesultone	Exotic	E.9
305	n-Propylamine	GC/MS, Dir. Inj.	E.4
306	Propylthiouracil	Exotic	E.9
307	2-Propyn-1-ol	GC/MS, Dir. Inj.	E.4
308	Pyridine	SW-846, 8240	E.2
309	Reserpine	SW-846, 8270	E.3
310	Resorcinol	SW-846, 8270	E.3
311	Saccharin and salts	Exotic	E.9
312	Safrol	SW-846, 8270	E.3
313	Selenious acid	SW-846, 7740	E.5
314	Selenium and compounds	SW-846, 7740	E.5
315	Selenium sulfide	SW-846, 7740	E.5
316	Selenourea	SW-846, 7740	E.5
317	Silver and compounds	SW-846, 6010	E.5
318	Silver cyanide	SW-846, 6010	E.5
319	Sodium cyanide	SW-846, 9010	E.10
320	Streptozotocin	Exotic	E.9
321	Strontium sulfide	SW-846, 6010	E.5
322	Strychnine and salts	AOAC - 38.068	E.10
323	1,2,4,5-Tetrachlorobenaene	SW-846, 8270	E.3

TABLE E.1 DANGEROUS WASTE CONSTITUENTS LIST (contd.)

	Constituent	Method[a]	Table
324	TCDD	SW-846, 8270	E.3
325	Tetrachloroethane	SW-846, 8240	E.2
326	1,1,1,2-Tetrachlorethane	SW-846, 8240	E.2
327	1,1,2,2-Tetrachlorethane	SW-846, 8240	E.2
328	Tetrachlorethylene	SW-846, 8240	E.2
329	Tetrachloromethane	SW-846, 8240	E.2
330	2,3,4,6-Tetrachlorophenol	SW-846, 8270	E.3
331	Tetraethyldithiopyrophosphate	Unstable	E.8
332	Tetraethyl lead	SW-846, 67010	E.5
333	Tetraethylpyrophosphate	Exotic	E.9
334	Tetranitromethane	Exotic	E.9
335	Thallium and compounds	SW-846, 7840	E.5
336	Thallic oxide	SW-846, 7840	E.5
337	Thallium (1) acetate	SW-846, 7840	E.5
338	Thallium (1) carbonate	SW-846, 7840	E.5
339	Thallium (1) chloride	SW-846, 7840	E.5
340	Thallium (1) nitrate	SW-846, 7840	E.5
341	Thallium selenite	SW-846, 7840	E.5
342	Thallium (1) sulfate	SW-846, 7840	E.5
343	Thioacetamide	Exotic	E.9
344	Thiosemicarbazide	Exotic	E.9
345	Thiourea	SW-846, 8330	E.10
346	Thiuram	SW-846, 8270	E.3
347	Toluene	SW-846, 8240	E.2
348	Toluenediamine	SW-846, 8270	E.3
349	o-Toluidine hydrochloride	SW-846, 8270	E.3
350	Tolulene diisocyanate	Unstable	E.8
351	Toxaphene	SW-846, 8080	E.6
352	Bromoform	SW-846, 8240	E.2
353	1,2,4-Trichlorobenzene	SW-846, 8270	E.3
354	1,1,1-Trichloroethane	SW-846, 8240	E.2
355	1,1,2-Trichloroethane	SW-846, 8240	E.2
356	Trichloroethene	SW-846, 8240	E.2

TABLE E.1. DANGEROUS WASTE CONSTITUENTS LIST (contd.)

	Constituent	Method[a]	Table
357	Trichloromethanethiol	SW-846, 8240	E.2
358	Trichloromonofluoromethane	SW-846, 8240	E.2
359	2,4,5-Trichlorophenol	SW-846, 8270	E.3
360	2,4,6-Trichlorophenol	SW-846, 8270	E.3
361	2,4,5-T	SW-846, 8150	E.6
362	2,4,5-TP (Silvex)	SW-846, 8150	E.6
363	Trichloropropane	SW-846, 8240	E.2
364	1,2,3-Trichloropropane	SW-846, 8240	E.2
365	0,0,0-Triethyl phosphorothioate	SW-846, 8270	E.3
366	sym-Trinitrobenzene	SW-846, 8270	E.3
367	Tris(1-aziridinyl) phosphine sulfide	Unstable	E.8
368	Tris(2,3-dibromopropyl) phosphate	SW-846, 8270	E.3
369	Trypan blue	Exotic	E.9
370	Uracil mustard	Exotic	E.9
371	Vanadic acid, ammonium salt	SW-846, 6010	E.5
372	Vanadium pentoxide	SW-846, 6010	E.5
373	Vinyl chloride	SW-846, 8240	E.2
374	Zinc cyanide	SW-846, 6010	E.5
375	Zinc phosphide	Unstable	E.8

(a) SW-846: Environmnental Protection Agency. 1982. Test Methods for Evaluating Solid Waste - Chemical/Physical Methods, SW-846.

SM: American Public Health Association. 1985. Standard Methods for the Examination of Water and Waste Water. APHA, Washington, D.C.

AOAC: Journal of the Association of Official Analytical Chemists.

TABLE E.2 VOLATILE ORGANICS

7	Acrolein
9	Acrylonitrile
31	Benzene
47	Bis(chloromethyl)ether
49	Bromoacetone
50	Methyl bromide
59	Carbon disulfide
72	Chlorobenzene
76	2-Chloroethyl vinyl ether
77	Chloroform
78	Methyl chloride
79	Chloromethyl methyl ether
91	Crotonaldehyde
111	1,2-Dibromo-3-chloropropane
112	1,2-Dibromoethane
113	Dibromomethane
120	1,4-Dichloro-2-butene
121	Dichlorodifluoromethane
122	1,1-Dichloroethane
123	1,2-Dichloroethane
124	trans-1,2-Dichloroethene
126	1,1-Dichloroethylene
127	Methylene chloride
133	1,2-Dichloropropane
136	1,3-Dichloropropene
140	N,N-Diethylhydrazine
155	1,1-Dimethylhydrazine
156	1,2-Dimethylhydrazine
168	Dioxane
206	Hydrogen sulfide
209	Iodomethane
226	Methacrylonitrile
227	Methanethiol

TABLE E.2 VOLATILE ORGANICS (contd.)

235 Methyl ethyl ketone
285 Pentachloroethane
308 Pyridine
325 Tetrachloroethane
326 1,1,1,2-Tetrachlorethane
327 1,1,2,2-Tetrachlorethane
328 Tetrachlorethylene
329 Tetrachloromethane
347 Toluene
352 Bromoform
354 1,1,1-Trichloroethane
355 1,1,2-Trichloroethane
356 Trichloroethane
357 Trichloromethanethiol
358 Trichloromonofluoromethane
363 Trichloropropane
364 1,2,3-Trichloropropane
373 Vinyl chloride

TABLE E.3 SEMI-VOLATILE ORGANICS

1	Acetonitrile
2	Acetophenone
4	2-Acetylaminofluorene
14	4-Aminobyphenyl
16	5-(Aminomethyl)-3-ioxazolol
17	Amitrole
18	Aniline
20	Aramite
25	Auramine
29	Benz[c]acridine
30	Benz[a]anthracene
33	Benzene, dichloromethyl-
34	Benzenethoil
35	Benzidine
36	Benzo[b]fluoranthene
37	Benzo[j]fluoranthene
38	Benzo[a]pyene
39	p Benzoquinone
41	Benzyl chloride
43	Bis(2-chloroethoxy)methane
44	Bis(2-chloroethyl) ether
45	Chlornaphazine
46	Bis(2-chloroisopropyl) ether
48	Bis(2-ethylhexyl) phthalate
51	4-Bromophenyl phenyl ether
54	Butyl benzyl phthalate
55	2-sec-Butyl-4,6-dinitrophenol
64	Chlorinated benzenes
70	Chloroalkyl ethers
71	p-chloraniline
74	p-Chloro-m-cresol
75	1-Chloro-2,3-epoxypropane
80	2-Chloronaphthalene

TABLE E.3 SEMI-VOLATILE ORGANICS (contd.)

81	2-Chlorophenol
85	Chrysene
90	Cresols
97	2-Cyclohexyl-4,6-dinitrophenol
104	Dibenz[a,h]acridine
105	Dibenz[a,j]acridine
106	Dibenz[a,h]anthracene
107	7H-Dibenzo[c,g]carbazole
108	Dibenzo[a,e]pyrene
109	Dibenzo[a,h]pyrene
110	Dibenzo[a,i]pyrene
114	Di-n-butyl phthalate
115	1,2-Dichlorobenzene
116	1,3-Dichlorobenzene
117	1,4-Dichlorobenzene
119	3,3'-Dichlorobenzidine
128	2,4-Dichlorophenol
129	2,6-Dichlorophenol
143	Diethyl phthalate
146	Dihydrosafrole
150	3,3'-Dimethoxybenzidine
151	p-Dimethylaminoazobenzene
152	7,12-Dimethylbenz[a]anthracene
153	3,3'-Dimethylbenzidine
157	Thiofanox
158	alpha,alpha-Dimethlphenethylamine
159	2,4-Dimethylphenol
160	Dimethyl phthalate
162	Dinitrobenzene
163	4,6-Dinitro-o-cresol and salts
164	2,4-Dinitrophenol
165	2,4-Dinitrotoluene
166	2,6-Dinitrotoluene

TABLE E.3 SEMI-VOLATILE ORGANICS (contd.)

167 Di-n-octyl phthalate
169 Diphenylamine
170 1,2-Diphenylhydrazine
171 Di-n-propylnitrosamine
179 Ethyleneimine
183 Ethyl methanesulfonate
184 Fluoranthene
194 Hexachlorobenzene
195 Hexachlorobutadiene
197 Hexachlorocyclopentadiene
198 Hexachloroethane
200 Hexachlorophene
201 Hexachloropropene
203 Hydrazine
208 Indeno(1,2,3-cd)pyrene
213 Isosafrole
222 Malononitrile
223 Melphalan
228 Methapyrilene
229 Metholonyl
231 2-Methylaziridine
232 3-Methylcholanthrene
234 4,4'-Methylenebis(2-chloroaniline)
237 2-Methyllactonitrile
238 Methyl methacrylate
239 Methyl methanesulfonate
240 2-Methyl-2-(methylthio)propionaldehyde-o-(methylcarbonyl)oxime
243 Methylthioracil
245 Naphthalene
246 1,4-Naphthoquinone
247 1-Naphthylamine
248 2-Naphthylamine
255 p-Nitroaniline

TABLE E.3 SEMI-VOLATILE ORGANICS (contd.)

256 Nitrobenzine
261 4-Nitrophenol
264 N-Nitrosodi-n-butylamine
265 N-Nitrosodiethanolamine
266 N-Nitrosodiethylamine
267 N-Nitrosodimethylamine
269 N-Nitrosomethylethylamine
271 N-Nitroso-N-methylurethane
272 N-Nitrosomethylvinylamine
273 N-Nitrosomorpholine
274 N-Nitrosonornicotine
275 N-Nitrosopiperidine
276 Nitrosopyrrolidine
278 5-Nitro-o-toluidine
284 Pentachlorobenzene
286 Pentachloronitrobenzene
287 Pentachlorophenol
288 Phenacetin
289 Phenol
290 Phenylenediamine
297 Phthalic acid esters
299 2-Picoline
303 Pronamide
309 Reserpine
310 Resorcinol
312 Safrol
323 1,2,4,5-Tetrachlorobenzene
324 2,3,7,8-TCDD
330 2,3,4,6-Tetrachlorophenol
346 Thiuram
348 Toluenediamine
349 o-Toluidine hydrochloride
353 1,2,4-Trichlorobenzene

TABLE E.3 SEMI-VOLATILE ORGANICS (contd.)

359 2,4,5-Trichlorophenol
360 2,4,6-Trichlorophenol
365 0,0,0-Triethyl phosphorothioate
366 sym-Trinitrobenzene
368 Tris(2,3-dibromopropyl) phosphate

TABLE E.4 ORGANICS BY GC/MS DIRECT INJECTION

8	Acrylamide
12	Allyl alcohol
61	Chloral
69	Chloroacetaldehyde
83	3-Chloropropionitrile
93	Cyanogen
134	Dichloropropanol
176	Ethyl carbamate
177	Ethyl cyanide
180	Ethylene oxide
182	Ethyl methacrylate
187	Fluoroacetic acid
190	Glycidylaldehyde
212	Isobutyl alcohol
236	Methyl hydrazine
305	n-Propylamine
307	2-Propyn-1-ol

TABLE E.5 CONSTITUENTS THAT ONLY REQUIRE ANALYSIS FOR METAL SPECIES

19	Antimony, NOS
21	Arsenic and compounds, NOS
22	Arsenic acid
23	Arsenic pentoxide
24	Arsenic trioxide
27	Barium and compounds, NOS
28	Barium cyanide
32	Benzenearsonic acid
42	Beryllium and compounds, NOS
56	Cadmium and compounds, NOS
57	Calcium chromate
84	Chromium and compounds, NOS
88	Copper cyanide
131	Dichlorophenylarsine
139	Diethylarsine
207	Hydroxydimethylarsine oxide
216	Lead and compounds, NOS
217	Lead acetate
218	Lead phosphate
219	Lead subacetate
224	Mercury fulminate
225	Mercury and compounds, NOS
250	Nickel and compounts, NOS
251	Nickel carbonyl
252	Nickel cyanide
280	Osmium tetroxide
291	Phenylmercury acetate
302	Potassium silver cyanide
313	Selenious acid
314	Selenium and compounds, NOS
315	Selenium sulfide
316	Selenourea
317	Silver and compounds, NOS

TABLE E.5 CONSTITUENTS THAT ONLY REQUIRE ANALYSIS FOR METAL SPECIES (contd.)

318 Silver cyanide
321 Strontium sulfide
332 Tetraethyl lead
335 Thallium and Compounds, NOS
336 Thallic oxide
337 Thallium acetate
338 Thallium carbonate
339 Thallium chloride
340 Thallium nitrate
341 Thallium selenite
342 Thallium sulfate
371 Vanadic acid, ammonium salt
372 Vanadium pentoxide
374 Zinc cyanide

TABLE E.6 PESTICIDES/HERBICIDES

11	Aldrin
63	Chlordane
73	Chlorobenzilate
100	DDD
101	DDE
102	DDT
130	2,4-D
137	Dieldrin
141	Carbophenothion
149	Dimethoate
172	Disulfoton
174	Endosulfan
175	Endrin
192	Heptachlor
193	Heptachlor epoxide
196	Lindane and isomers
214	Kepone
230	Methoxychlor
242	Methyl parathion
283	Parathion
300	Polychlorinated biphenyl
351	Toxaphene
361	2,4,5-T
362	2,4,5-TP Silvex

TABLE E.7 COMPOUNDS TO BE ANALYZED BY CLASS

TOX:

65 Chlorinated ethane
66 Chlorinated fluorocarbons
67 Chlorinated naphthalene
68 Chlorinated phenol
118 Dichlorobenzene
125 Dichloroehtylene
132 Dichloropropane
135 Dichloropropene
191 Halomethane

TOC:

87 Coal tars
89 Creosote

Ammonium:

263 Nitrosamine

TABLE E.8 CONSTITUENTS UNSTABLE IN WATER

5	Acetyl chloride
13	Aluminum phosphide
40	Benzotrichloride
53	2-butanone peroxide
60	Carbon oxyfluoride
138	1,2:3,4-diepoxybutane
148	Diisopropylfluorophosphate
154	Dimethylcarbamoyl chloride
161	Dimethyl sulfate
185	Fluorine
205	Hydrofluoric acid
211	Methyl isocyanate
220	Maleic anhydride
233	Methyl chlorocarbonate
257	Nitrogen dioxide
293	Phosgene
295	Phorate
296	Famphur
298	Phthalic anhydride
331	Tetraethyldithiopyroiphosphate
350	Toluene diisocyanate
367	Tris (1-aziridinyl) phosphine sulfide
375	Zinc phosphide

TABLE E.9 CONSTITUENTS FOR WHICH NO ANALYSIS IS AVAILABLE

10	Aflatoxins
15	Mitomycin C
26	Azaserine
52	Brucine
62	Chlorambucil
96	Cycasin
98	Cyclophosphamide
99	Daunomycin
103	Diallate
142	O,O-diethylphosphoric acid, o-p-nitrophenyl ester
144	Thionazin
147	3,4-dihydroxyu-alpha-(methylamino) methyl benzyl alcohol
173	2,4-dithiobiuret
178	Ethylenebisdithiocarbamic acid
186	2-fluoroacetamide
199	Hexachlorohyxahydro-endo, endo-dimethanonaphthalene
202	Hexaethyl thetrphosphyate
210	Iron dextran
215	Lasiocarpine
241	N-methyl-N'-nitro-N-nitrosoguanidine
244	Mustard gas
254	Nitric oxide
258	Nitrogen mustard - HCl salt
259	Nitrogen mustard N-oxide and HCl salt
260	Nitroglycerin
262	4-nitroquinoline
277	N-nitrososacrosine
279	Octamethylpyrophosphoramide
281	Endothol
282	Paraldehyde
294	Phosphine
304	1,3-propanesultone
306	Propylthiouracil

TABLE E.9 CONSTITUENTS FOR WHICH NO ANALYSIS IS AVAILABLE (contd.)

311 Saccharin and salts
320 Streptozotocin
333 Tetraethylpyrophosphate
334 Tetranitromethane
343 Thioacetamide
344 Thiosemicarbazide
369 Trypan blue
370 Uracil mustard

TABLE E.10 MISCELLANEOUS ORGANICS AND INORGANICS

86	Citrus red No. 2
92	Cyanide
58	Calcium cyanide
204	Hydrocyanic acid
301	Potassium cyanide
319	Sodium cyanide
94	Cyanogen bromide
95	Cyanogen chloride
188	Formaldehyde
189	Formic acid
221	Maleic hydrazide
253	Nicotine and salts
322	Strychnine
345	Thiourea
6	1-Acetyl-2-thiourea
82	1-(o-Chlorophenyl)thiourea
145	Diethylstilbesterol
181	Ethylenethiourea
249	1-Naphthyl-2-thiourea
268	N-Nitroso-N-ethylurea
270	N-Nitroso-N-methylurea
292	N-Phenylthiourea

APPENDIX F

LOCATION OF OFFICIAL COPIES OF THE CLOSURE AND POST-CLOSURE PLAN

APPENDIX F
LOCATION OF OFFICIAL COPIES OF THE CLOSURE AND POST-CLOSURE PLAN

Two copies of the 100 Area 1301-N Liquid Waste Disposal Facility Closure/ Post-Closure Plan are official copies of the closure plan. These official copies are located at the following office:

U.S. Department of Energy-Richland Operations Office
Federal Building
825 Jadwin Avenue
P.O. Box 550
Richland, WA 99352

APPENDIX G

PERSON RESPONSIBLE FOR STORAGE AND UPDATING COPIES OF THE CLOSURE/POST-CLOSURE PLAN

APPENDIX G
PERSON RESPONSIBLE FOR STORAGE AND UPDATING COPIES OF THE CLOSURE/POST-CLOSURE PLAN

The following office will be responsible for updating the official copies of the Closure/Post-Closure Plan for the 100 Area 1301-N Liquid Waste Disposal Facility:

Chief
Radiological and Environmental Safety Branch
Environment, Safety and Health Division
U.S. Department of Energy - Richland Operations Office
Federal Building - Room 619
825 Jadwin Avenue
P.O. Box 550
Richland, WA 99352
(509) 376-7387

APPENDIX H

CERTIFICATION OF CLOSURE FOR THE 100 AREA 1301-N LIQUID WASTE DISPOSAL FACILITY

APPENDIX H
CERTIFICATION OF CLOSURE FOR THE 100 AREA 1301-N LIQUID WASTE DISPOSAL FACILITY

When closure is completed, DOE-RL will submit to the regulating authority both a self-certification and a certification by an independent registered professional engineer that the 100 Area 1301-N Liquid Waste Disposal Facility have been closed in accordance with the specification of the approved plan.

Owner/Operator Closure Certification

The DOE-RL will self-certify with the following document or a document similar to it:

> I, (name), an authorized representative of the U.S. Department of Energy-Richland Operations Office located at the Federal Building, 825 Jadwin Avenue, Richland, Washington, hereby state and certify that the 100 Area 1301-N Liquid Waste Disposal Facility, to the best of my knowledge and belief, have been closed in accordance with the attached approved closure plan, and that the closure was completed on (date). (Signature and date)

Professional Engineer Closure Certification

The DOE-RL will engage an independent registered professional engineer to certify that the facility has been closed in accordance with this approved closure plan. The DOE-RL will require the engineer to sign the following document or a document similar to it:

> I, (name), a certified professional engineer, hereby certify, to the best of my knowledge and belief, that I have made visual inspection(s) of the 100 Area 1301-N Liquid Waste Disposal Facility and that closure of the aforementioned facilities has been performed in accordance with the attached approved closure plan. (Signature, date, state professional engineer license number, business address, and phone number)

WP #9148A